HARBOR POINT

FINAL

ENVIRONMENTAL IMPACT REPORT

EOEA # 5076

TECHNICAL APPENDICES

VOLUME 2 OF 2

BOSTON, MASSACHUSETTS

HARBOR POINT

(REDEVELOPMENT OF THE
COLUMBIA POINT HOUSING PROJECT)

FINAL
ENVIRONMENTAL IMPACT REPORT
EOEA #5076

TECHNICAL APPENDICES
VOLUME 2 OF 2

BOSTON, MASSACHUSETTS

TECHNICAL APPENDICES

PART 2 of 2

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APPENDIX I

TIDELAND LICENSES

PENINSULA PARTNERS
One Heritage Drive • Quincy, MA 02171
(617) 328-3100

July 8, 1985

John Zajac, Jr.
Chief Engineer
Department of Environmental Quality Engineering
Division of Wetlands/Waterways Regulation
One Winter Street
Boston, MA 02108

Re: Columbia Point Redevelopment
Chapter 91 License File No. 85W-112

Dear Mr. Zajac:

This letter is filed in support of the application for a license pursuant to M.G.L. ch. 91 ("Chapter 91") to engage in certain activities on filled tidelands at Columbia Point in Boston. The activities at Columbia Point that are subject to the Chapter 91 license requirement constitute part of the Harbor Point Project (the "Project"), which is to be carried out by Peninsula Partners and the Boston Housing Authority. The Project consists of the following components:

(1) razing portions of the existing Columbia Point public housing project;

(2) reconstruction and maintenance of 1400 new rental units and related community facilities; and

(3) maintenance of a proposed public waterfront park by the Project development team and funding and construction of the park by an entity other than the development team.

The Project has been planned with the active cooperation of a number of public agencies. In order to address the problems presented by the deterioration of Columbia Point, the Boston Housing Authority, the Boston Redevelopment Authority, the U.S. Department of Housing and Urban Development, and the Columbia Point Community Task Force determined that mixed-income residential development should be constructed. The development team was selected through a public competitive process.

We believe that the application and supplementary materials already submitted to your office demonstrate that the requirements for issuance of a Chapter 91 license have been met. This letter provides further information with respect to the Project's compliance with these requirements. In this regard, we note that the portion of the Project site that is subject to the Chapter 91 license requirement has been delineated in materials already presented to you.

Section 18 of Chapter 91 provides that the Department of Environmental Quality Engineering may license a project involving non-water dependent uses on tidelands if it determines that the following conditions are met:

(1) the project serves a proper public purpose;

(2) the project provides a greater public benefit than public detriment to the rights of the public in the affected tidelands; and

(3) the project is consistent with the policies of the Massachusetts coastal zone management program.

The following discussion describes in more detail how the Project satisfies each of these three statutory requirements.

I. <u>The Project Serves a Proper Public Purpose</u>.

The Project will serve a number of important public purposes. These include the following:

A. <u>Elimination of existing blight</u>. The sorry conditions currently existing at Columbia Point are well-known. Twenty out of the 27 buildings at the housing project are now boarded up and abandoned, and it is generally agreed that these buildings cannot be rehabilitated. A recreation area at the site is poorly maintained and underused. The area along the water is in poor physical condition, with deteriorating riprap, many weeds, and other signs of neglect. The current design of the area, with a dense clustering of high-rise buildings, affords little view of the water, either for area residents or for citizens of surrounding communities.

In place of these conditions, the Project will provide an attractive and well-planned mixed-income residential development, with increased open space and orderly street layout. The site will be opened both physically and visually by a design that centers around a mall running from Mount Vernon Street to the water. In addition, a waterfront park will be created for public use. Improved physical conditions, as well as the changes in design and layout, will create a

public impression that the development is open and safe, thereby promoting public use of the recreational facilities.

B. Expansion and improvement of low-income rental housing. Currently, only 350 residential units at Columbia Point are inhabited. Residents suffer from the undesirable living conditions resulting from Columbia Point's isolation and physical deterioration.

Upon completion of the Project, 400 low-income rental units will be available, thereby accommodating all current tenants. Moreover, the quality of life for these residents will be significantly enhanced. They will benefit from increased services and amenities, the advantages of living in a mixed-income community, and the improved physical environment of the redesigned residential development. The generous public funding expected for the Project is convincing testimony to the importance of the low-income housing improvements that the Project will provide.

C. Improvement of waterfront park facilities. An active recreational area currently located at the Project site is isolated and in poor physical condition. Residents and non-residents alike have concerns about personal safety in this area. For these reasons, this recreational area is rarely used by the public.

The Project includes the creation of an approximately 5.5 acre park along one half mile of waterfront. This park constitutes a significant water-dependent use of the filled tidelands at the site. The park will provide opportunities for biking, walking, jogging, and fishing, as well as picnicking sites, a viewing terrace, and a beach area. The park will form a link in the regional waterfront park system which is proposed to run from Castle Island to the Neponset River.

Public access to the new waterfront park will be facilitated by parking that is available nearby at the University of Massachusetts and the Kennedy Library and by a public bus stop in the center of the development. Because of the rehabilitation of the neighboring housing project and improvement of services, the public perception of the waterfront area will change, and public use of this area will increase.

D. Expansion of rental housing supply. In addition to improvement of the low-income rental stock, the Project will provide 1000 new market and moderate rate rental units. More importantly, the Project will create a vital, racially and economically mixed community in place of the existing housing project that has physically and socially isolated its low-income residents.

E. Additional public purposes. The Project will serve several additional purposes. City property tax revenue will increase once new buildings are constructed and existing buildings are rehabilitated. In addition, low-income residents will be eligible for employment in the development, construction, and management of the Project, and programs will be implemented to encourage development of such employment opportunities.

II. The Public Benefits Will Outweigh the Public Detriments to the Rights of the Public in the Tidelands.

As described in detail above, the Project provides extensive public benefits. Many of these directly affect water-dependent uses and so will enhance public enjoyment of the tidelands. In addition, as set forth below, the Project has been designed to minimize any potential detriments that might result from the anticipated changes at the Columbia Point site.

Revitalization of the waterfront area is the principal public benefit relating to water-dependent uses, and it alone outweighs any of the accompanying detriments. As described more fully above, the Project will revitalize the waterfront area, which is now blighted and rarely used by the public. A waterfront recreational area that is attractive, well-maintained, and inviting to the public will be provided. The residential development has been designed to increase and enhance water views for residents of both the development and the neighboring communities.

The waterfront park that will be built as part of the Project will result in an increase in actual public use of the waterfront area. Considerable attention has been devoted to design features, including physical features of the site as well as landscaping and signs, that will make the park accessible and inviting to the general public. Bikeways and walkways will provide access to the waterfront. Parking will be available at sites adjacent to both ends of the park, and public buses will stop nearby. The planned uses for the waterfront area are compatible with the uses now existing at other waterfront areas on Boston Harbor, and, in fact, the planned park will form a link in a proposed "necklace" of parks along Dorchester Bay.

While the Project will result in the elimination of an existing active recreational area, that area is now rarely used, poorly maintained, and unsafe. Further, the activites for which this area was intended to be utilized are unrelated to the water. Indeed, the Boston Redevelopment Authority is now developing plans for the creation of new active recreational facilities at other, more suitable sites in the vicinity of the Project. The unique features of the waterfront

location are best appreciated through the kinds of activities, such as picnicking, viewing, or walking, that will be encouraged at the waterfront park planned as part of the Project.

Although the Project may be expected to have short-term noise and air quality impacts of the type customarily associated with construction activities, these effects will be minimized by use of standard control practices. The Project has been planned so that there will be no permanent negative impacts on the Project site or neighboring sites. In fact, as discussed above, there will be considerable long-term improvements arising from the construction of the residential development and the general improvement in the design and maintenance of the site. After construction, existing wind impacts in the area of the Project should be significantly reduced. In addition, the layout of the Project will result in a reduction of current shadow impacts, with particular attention to the waterfront park area where there will be sunny locations for public enjoyment throughout the day in every season.

In sum, the Project will result in a major redevelopment of a waterfront area that has suffered from serious, longstanding problems. The changes planned for the area will necessarily alter the layout and land allocation at the site. However, whatever minor negative impacts may result from these changes are far outweighed by the public benefits that will be derived from the redevelopment and revitalization of the peninsula.

III. <u>The Project Is Consistent With the Policies of the Massachusetts Coastal Zone Management Program.</u>

The Coastal Zone Management Program encompasses twenty-seven policies. 301 C.M.R. § 20.05(3). Fifteen of these policies, which are set forth and discussed below, are relevant to the Project.

A. <u>Environmental impacts of shoreline construction</u>: Policies 1, 2, 3, 4, 5, and 10. The object of these policies is that shoreline projects be conducted in such a manner that they do not damage water quality or other marine resources and that they conform to federal and state requirements relating to the protection of the environment.

The site is a significantly altered urban waterfront site. Sensitive environmental resources are not found there or in the immediate vicinity. Water quality will be protected at the site during construction through compliance with an order of conditions to be issued by the Boston Conservation Commission pursuant to the Massachusetts Wetlands Protection Act, M.G.L. ch. 131, § 40. In addition, the Project will be carried out in a manner that minimizes any potential negative environmental impacts and that is in conformity with all applicable statutes and regulations relating to environmental protection. Overall,

there will be long range benefits to the water and contiguous land areas as a result of the improvement of the condition of the riprap at the water's edge, improved maintenance of the waterfront area, and the elimination of blighted and unsafe conditions that currently exist at the site.

B. Compatibility with the surrounding community: Policies 12 and 18. The object of these policies is that proposed coastal developments be compatible with the area's scenic and historic resources and the character of the surrounding community.

The Project will not change the residential character of the site. It will, however, improve that character by upgrading the physical condition of housing at the site and by eliminating the physical and social features that have contributed to the isolation of Columbia Point from neighboring communities. Further, the Project is not located at or near a site of significant historical value, and thus considerations of historic preservation are not applicable.

C. Revitalization of the waterfront: Policies 20 and 27. The object of these policies is that coastal development projects contribute to the redevelopment, revitalization, and enhancement of urban waterfronts and the expansion of visual access and water-dependent uses.

The Project will cause the revitalization of a significant segment of the urban waterfront. The blighted conditions at Columbia Point will be eliminated. The new residential development will be designed so that water views will be maximized for the enjoyment of the residents of both the development itself and neighboring communities. Improvements at the site will eliminate public fear of crime and vandalism and so will encourage public use and enjoyment of the waterfront area.

D. Expansion of recreational facilities: Policies 13, 21, 22, 23, and 24. The object of these policies is that coastal area developments be designed to increase recreational opportunities for the public, through such means as improved public access, links to other coastal recreational areas, and improved maintenance of recreational facilities.

The creation of a new waterfront recreational area, with opportunities for waterside hiking, biking, picnicking, and viewing, will result in a significant expansion of public recreational opportunities and in water-dependent uses at the site. Although an existing active recreational area will be eliminated, as described above, it has not served the public because of its isolation and deteriorated condition. In contrast, the new waterfront park area will invite public use

The new park will be linked to other coastal recreation sites by routes for use by bicyclists and pedestrians, and it will be easily accessible to motorists and to users of public transportation.

We believe that the portion of the Project that is subject to Chapter 91 fulfills all of the statutory criteria for the granting of a Chapter 91 license. Please do not hesitate to contact us if we can provide you with further information on any of the points discussed in this letter or on any other matters relating to the Project.

Sincerely yours,

Martha L. Jones

Martha L. Jones
Vice President

cc: Doris Bunte
Rod Solomon

0637/C
7/1/85

BOSTON
REDEVELOPMENT
AUTHORITY

One City Hall Square
Boston, MA 02201
(617) 722-4300

July 8, 1985

Mr. John Zajac, Jr.
Chief Engineer
Department of Environmental
Quality Engineering
Division of Wetlands
One Winter Street, 7th Floor
Boston, MA 02108

Dear Mr. Zajac:

The redevelopment of the Columbia Point housing project as the Harbor Point community will create major public benefits to the City of Boston and the Commonwealth. The present site includes a partially abandoned public housing project, as well as an inaccessible and decayed open area. The present environment is inimical to the family and community life of present and future residents. The solution to this desperate problem has been the object of the Columbia Point residents, the Boston Redevelopment Authority, the Boston Housing Authority, the Commonwealth and the Federal government for over a decade.

As a result of the combined efforts of these parties, we now have before us a project that will provide 1,400 decent and affordable rental housing units for the citizens of Boston, the elimination of a major physical and social blight in the city, as well as financial benefits. Real estate taxes will increase to more that $1 million per year. The $12 million UDAG and the $8.7 million Urban Initiatives Grant will be repaid to the City. In addition, the Partnership will assume present City responsibilities of maintaining the roads, removing the snow and collecting trash.

As the design of this project has evolved, the BRA has been deeply involved in the development of the plans for the present project, as well as future redevelopment proposals for the peninsula. As a public partner with the Boston Housing Authority and Columbia Point Community Task Force, Inc. we conducted the developer selection process for this project which culminated in the Authority's tentative designation of the Peninsula Partnership in October 1983. Since then, the BRA has conducted the design review function, provided assistance with public funding, in particular UDAG, and carried out traffic planning and coordination of park planning activities.

The BRA has done extensive design review of the proposed Harbor Point development over the past year and a half, both individually and jointly with the MHFA and the BHA. During that period, the BRA has been the reviewing agency with the greatest concern for the provision of appropriate public park space at Harbor Point. We have sought a reasonable balance between the needs of the 1400 housing units and their related parking, open space and other amenities, and the needs of the public for access to and use of this beautiful waterfront.

Specific changes at the BRA's request which have occurred to the site plan to benefit the public include the following:

- considerable enlargement of the waterfront park area, including increasing the minimum public easement from 30 feet to 50 feet and substantially increasing the size of the park node at the eastern point;
- the moving of buildings back from the waterfront, in particular the eastern and western mid-rises;
- the rotation of the tower elements on several of the mid-rises buildings away from the waterfront;
- the reduction in height of the mid-rise buildings;
- the consolidation of the clubhouse/pools area.

Other changes to the site plan have been made at our request including the redesigning of the parking lots to provide more open space and the provision of structured parking to reduce the amount of on-site paving. At its June 13, 1985 meeting, the Authority voted to approve Peninsula Partners' request to designate the site as a Planned Development Area (PDA), thereby approving the design plans and concept.

As you know, the BRA is committed to the total revitalization of the waterfront areas throughout Boston Harbor and has so stated in the Harborpark plan. With the changes which have been made to the Harbor Point plan, the project is now consistent with the goals and objectives of Harborpark for public access, for an appropriate setback of the private area from the public park, for the treatment of the parkland space, and for the stepping down of buildings to the waterfront.

The BRA has committed to continue its efforts to carry out the Harborpark plan at Columbia Point by working with the other appropriate agencies and Columbia Point owners, and its consultant, Carol Johnson, to develop plans for a continuous public waterfront park from Mother's Rest to John F. Kennedy Library. This park would fill a major gap in an open space system which now starts at Castle Island, stops at Mother's Rest, starts again at the library and continues around the University of Massachusetts. It will link the water's edge park to be created in conjunction with Harbor Point to this park system to provide a major new harbor amenity accessible to all.

In conclusion, I want to emphasize the BRA's strong support for this project and our belief in the enormous public benefit which will be created by the Harbor Point project.

Sincerely,

Stephen Coyle
Director

SC:bap

Doc 199482
Rec'd 12-5-51

The Commonwealth of Massachusetts

35

Whereas, the Boston Housing Authority--------------------

ton--------, in the County of Suffolk------------ and Commonwealth
d, have applied to the Port of Boston Authority for license to place and
in fill off Mount Vernon Street in the Dorchester District
ton, in and over the tidewaters of Old Harbor Bay, in the
f Boston and County of Suffolk--------------------------

e submitted plans of the same; and whereas due notice of said application, and of
and place fixed for a hearing thereon, has been given, as required by law, to the
and Council---of the City---------of Boston------------- ;

m, said Authority, having heard all parties desiring to be heard, and having fully
ed said application, hereby, ~~subject to the approval of the Governor and Council~~,
es and licenses the said --

Housing Authority---------- , subject to the provisions of the ninety-
pter of the General Laws, and of all laws which are or may be in force applicable
to place and maintain fill off Mount Vernon Street in the
ster District of Boston, in and over the tidewaters of
rbor Bay in the City of Boston, in conformity with the
anying plan No. 185.
illing may be placed and maintained within the area outlined
e and hatched in red as shown on said plan, and in accord-
ith the details there indicated, subject to the following
ions:
lling shall be commenced at the easterly extremity of the
o be filled. A dike shall be constructed of selected
al free from rubbish, as a jetty extending along the easterly
Concurrently with the jetty construction the easterly and

21

northerly sides, as they are finished, shall be covered with rip-rap quarry grout or quarry chips to a thickness of not less than 18 inches, 80% consisting of pieces weighing 200 pounds or more. After the aforesaid jetty is constructed, the shore can be extended out as shown on the accompanying drawing, commencing at the easterly end and working in toward the west. As the fill reaches the limits authorized, the slope shall be covered with a 12-inch blanket of quarry chips, rip-rap, or quarry grout.

2. No rubbish fill shall be deposited in the tidewaters except during the period of the year from November 1 to April 1.

3. At the end of three years after the date of issuance of this license, a permanent seawall, bulkhead, or rip-rap slope shall be constructed. Plans of the proposed permanent construction shall be submitted to the Port of Boston Authority for approval.

4. No fill shall be placed in the tide-waters in the area authorized by this license except when the tide-water is at a level of three feet above mean low water or lower.

5. In lieu of a charge for tide-water displacement the Boston Housing Authority shall pay all costs of maintaining an Inspector from the Port of Boston Authority to insure that provisions of the license are adhered to.

6. The outboard slope of the finished fill under this license shall not be steeper than two (2) horizontal to one (1) vertical.

7. In the process of placing the fill in the tide-waters, a proper and adequate floating boom shall be installed and maintained to prevent the escape of flotsam from the fill area. The surface of the fill area shall be covered with selected fill material which is free of rubbish and other organic material as a blanket to prevent the escape of obnoxious odors from the fill underneath.

8. By the acceptance of this license the Boston Housing Authority agrees to adhere and comply with all conditions herein, and in the event of non-compliance, this license shall be null and void.

This license is granted subject to the laws of the United States.

The plan of said work, numbered ----------185------------ is on file in the office of said Authority, and duplicate of said plan accompanies this License, and is to be referred to as a part hereof.

The cost of maintaining an Inspector from the Port of Boston Authority ~~amount of tide-water displaced by the work hereby authorized~~ shall be ascertained by said Authority, and compensation therefor shall be made by the said Boston Housing Authority---------------------------------------its ~~heirs~~/successors

and assigns, ~~by paying into the treasury of the Commonwealth~~

~~cents for each cubic yard so displaced, being the amount hereby assessed by said Authority~~.

Nothing in this License shall be so construed as to impair the legal rights of any person.

This License shall be void unless the same and the accompanying plan are recorded within one year from the date hereof, in the Registry of Deeds for the District of the County of Suffolk.

In Witness Whereof, said Port of Boston Authority have hereunto set their hands this twenty-third-------- day of November---------------- in the year nineteen hundred and fifty one.

John R. Kevey
Chairman

Bernard B. Baldwin
Commissioner

Walter F. McDonough
Commissioner

Commissioner

Commissioner

Port of Boston Authority

THE COMMONWEALTH OF MASSACHUSETTS

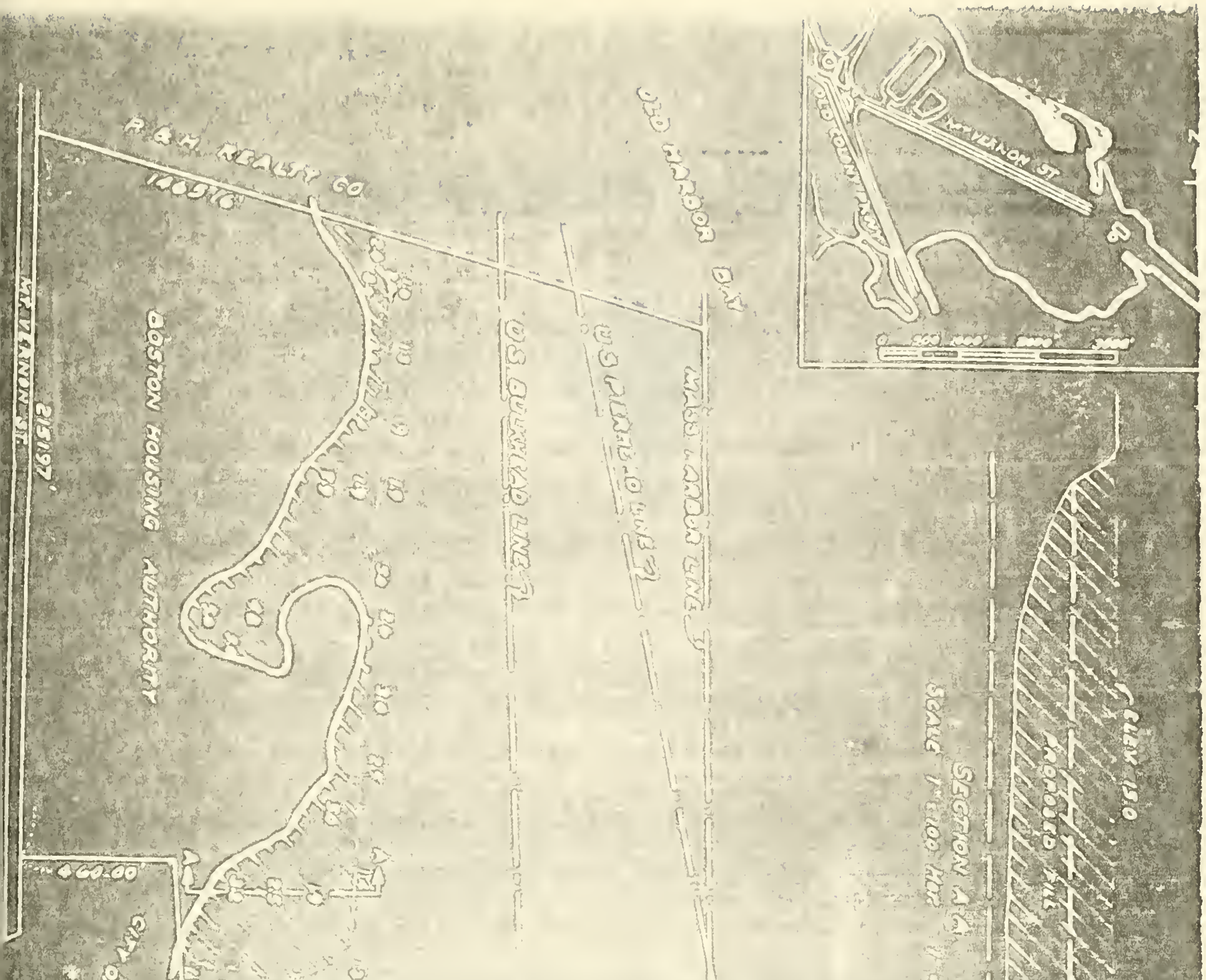
~~This license is approved in consideration of the payment into the treasury of the Commonwealth by the said of the further sum of~~

~~the amount determined by the Governor and council as a just and equitable charge for rights and privileges hereby granted in land of the Commonwealth.~~

BOSTON, ...

~~Approved by the Governor and Council.~~

....
~~Executive Secretary.~~



PLAN TO ACCOMPANY
OF BOSTON HOUSING
TO FILL SOLID IN OLD HARBOR
BOSTON, MASS.

CERTIFY THE
AS BEING

NOV. 23 1951
BOSTON AUTHORITY

121

Form WD 54.

1m—5-42-9649

Doc #. 167401
rec'd 3-22-45

The Commonwealth of Massachusetts

No. 2729 ← mor shown on Sh G. 3ma 1900

Whereas, the Boston Edison Company,------------------------

of Boston --------, in the County of Suffolk----------and Commonwealth aforesaid, has applied to the Department of Public Works for license to maintain filling as placed and to place additional solid fill in Dorchester Bay at its property in the city of Boston,------------------------------

and has submitted plans of the same; and whereas due notice of said application, and of the time and place fixed for a hearing thereon, has been given, as required by law, to the Mayor and City Council --- of the ---City ----- of Boston ------------;

Now, said Department, having heard all parties desiring to be heard, and having fully considered said application, hereby, ~~subject to the approval of the Governor and Council~~, authorizes and licenses the said Boston Edison Company ---------------------

-----------------------------------, subject to the provisions of the ninety-first chapter of the General Laws, and of all laws which are or may be in force applicable thereto, to maintain filling as placed and to place additional solid fill in Dorchester Bay at its property in the city of Boston, in conformity with the accompanying plan No. 2729.

The area from the mean high water line to a line 120 feet inside of the United States Bulkhead Line may be filled solid, as indicated on said plan. The fill may be placed with the top at

and assigns, by paying into the treasury of the Commonwealth ...

seven (7) cents for each cubic yard so displaced, being the amount hereby assessed by said Department.

Nothing in this License shall be so construed as to impair the legal rights of any person.

This License shall be void unless the same and the accompanying plan are recorded within one year from the date hereof, in the Registry of Deeds for the --------- ~~District of the~~ County of Suffolk.

In Witness Whereof, said Department of Public Works have hereunto set their hands this sixteenth.............. day of January------- -------- in the year nineteen hundred and forty-five.

Coburn

Raymond W. Coburn
Acting Commissioner

George W. Dehryver

Department of Public Works

Approved:

Richard K. Hale
Richard K. Hale
Director, Division of Waterways

~~THE COMMONWEALTH OF MASSACHUSETTS~~

~~This license is approved in consideration of the payment into the treasury of the Commonwealth by the said~~

~~of the further sum of~~

~~the amount determined by the Governor and council as a just and equitable charge for rights and privileges hereby granted in land of the Commonwealth.~~

~~Boston,~~ .....

~~Approved by the Governor and Council.~~

~~Executive Secretary.~~

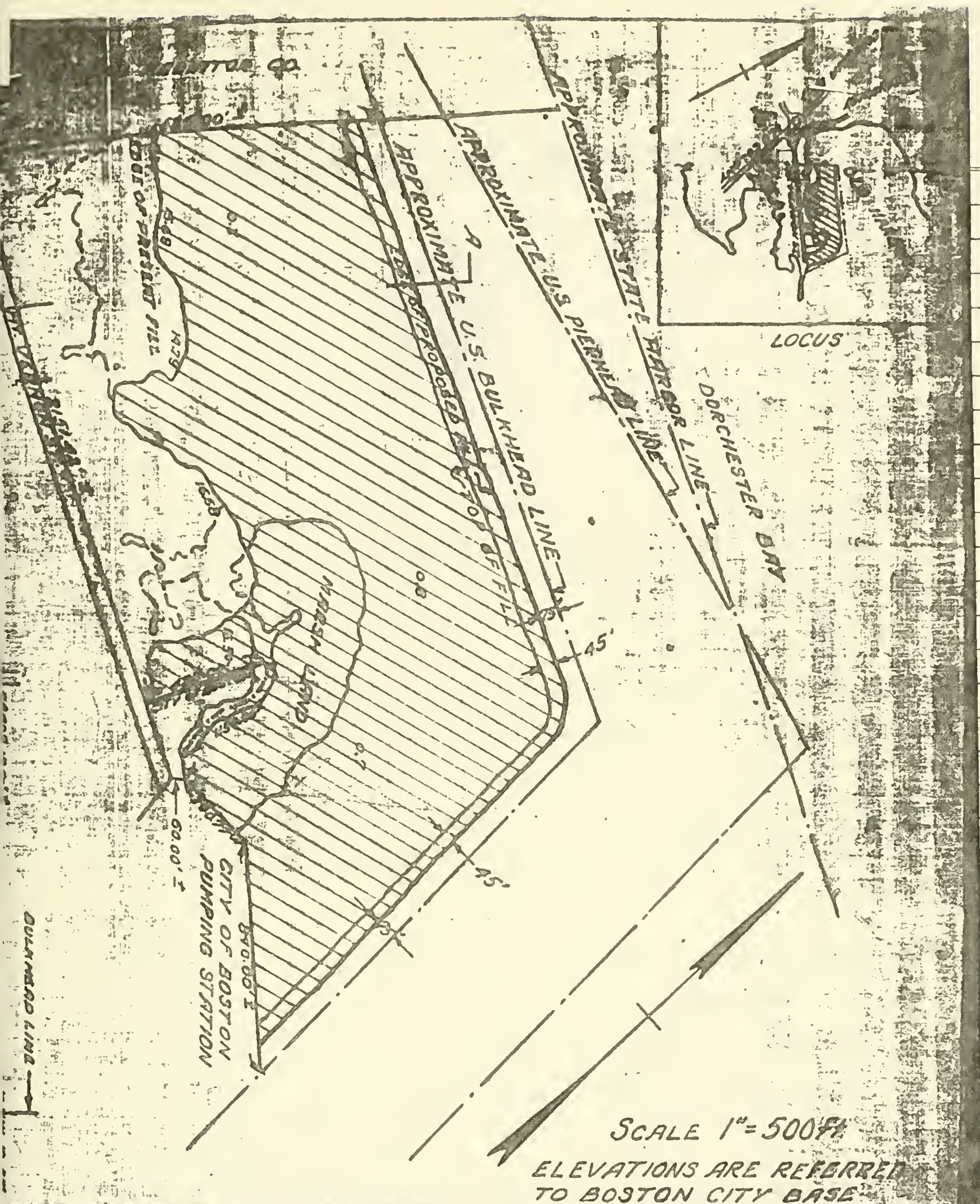
about elevation 15.5 and slope of 3 to 1 along the Bulkhead Line, the toe of the slope to be kept about 75 feet inside of said Bulkhead Line, as shown on said plan.

Filling may be maintained as placed within an area about [illegible] feet by 250 feet, as shown on said plan.

All filling deposited shall be so placed as to prevent any escape of material outside the boundaries of property of the licensee. --

The plan of said work, numbered ---------27[illegible]------------- is on file in the office of said Department, and duplicate of said plan accompanies this License, and is to be referred to as a part hereof.

The amount of tide-water displaced by the work hereby authorized shall be ascertained by said Department, and compensation therefor shall be made by the said -------------
Boston Edison Company, Inc ------------------------ heirs, successors



AN TO ACCOMPANY PETITION
OF THE BOSTON EDISON CO.
ILL SOLID AT ITS PROPERTY
MT. VERNON ST. BOSTON MASS.
RCHESTER BAY)
CEMBER 19 1944

NO. 2729
APPROVED BY DEPARTMENT OF PUBLIC WO
JANUARY 16, 1945

Raymond W. Coleman — ACTING COMMISSIONER OF PUBLIC WORKS
George W. Cohrynes — ASSOCIATE COMMISSIONER
Richard K. Hale

Form WD 54.
1m-9-'35. No. 5520.

The Commonwealth of Massachusetts

Doc. # 142692
rec'd 5-16 39

No. 1960.

Whereas, Mary E. Day,------------------------------------

of Boston-----------, in the County of Suffolk------------ and Commonwealth aforesaid, has applied to the Department of Public Works for license to build and maintain a bulkhead and to fill solid in Dorchester Bay at her property in the city of Boston,--

and has submitted plans of the same; and whereas due notice of said application, and of the time and place fixed for a hearing thereon, has been given, as required by law, to the ---------Mayor and City Council---of the city--- of Boston--------------------- ;

Now, said Department, having heard all parties desiring to be heard, and having fully considered said application, hereby ~~subject to the approval of the Governor and Council~~ authorizes and licenses the said

Mary E. Day-------------------------------, subject to the provisions of the ninety-first chapter of the General Laws, and of all laws which are or may be in force applicable thereto, to build and maintain a bulkhead and to fill solid in Dorchester Bay at her property in the city of Boston, in conformity with the accompanying plan No. 1960.

A pile and timber bulkhead about 3835 feet long may be built on lines marked B-C-D on said plan, in the location shown on said plan and in accordance with the details of

construction there indicated.

The area of tide water on property of the licensee between said bulkhead and the mean high water line may be filled solid as indicated on said plan. Until said bulkhead is built the toe of the slope of the material used as filling shall be kept at least 50 feet back from the United States Bulkhead Line and the line of the proposed bulkhead shown on said plan.

All filling deposited shall be so placed as to prevent any escape of material outside the boundaries of property of the licensee.

The plan of said work, numbered 1960, is on file in the office of said Department, and duplicate of said plan accompanies this License, and is to be referred to as a part hereof.

The amount of tide-water displaced by the work hereby authorized shall be ascertained by said Department, and compensation therefor shall be made by the said Mary E. Day, her heirs, successors

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and assigns, by paying into the treasury of the Commonwealth ------------------------

seven (7)--------- cents for each cubic yard so displaced, being the amount hereby assessed by said Department.

Nothing in this License shall be so construed as to impair the legal rights of any person.

This License shall be void unless the same and the accompanying plan are recorded within one year from the date hereof, in the Registry of Deeds for the ---------------- ~~District of the~~ County of Suffolk.

In Witness Whereof, said Department of Public Works have hereunto set their hands this seventeenth--------------- day of May,------------------- in the year nineteen hundred and thirty-eight.

W. F. Callahan
Richard K. Hale
Frank C. Kane

Department of Public Works

~~THE COMMONWEALTH OF MASSACHUSETTS~~

~~This license is approved in consideration of the payment into the treasury of the Commonwealth by the~~ said

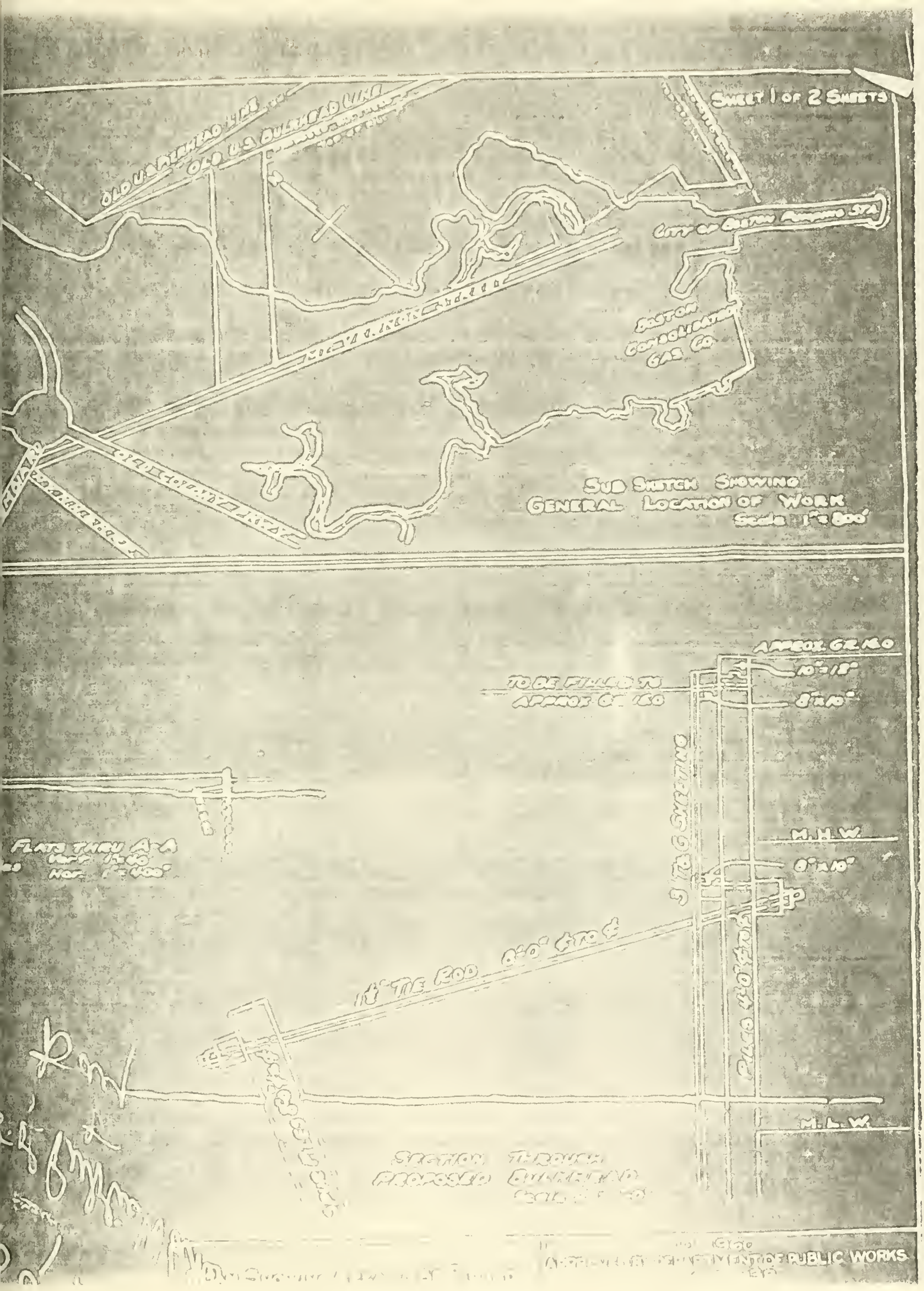
of the further sum of ,

the amount determined by the Governor and Council as a just and equitable charge for rights and privileges ~~hereby granted in land of the Commonwealth.~~

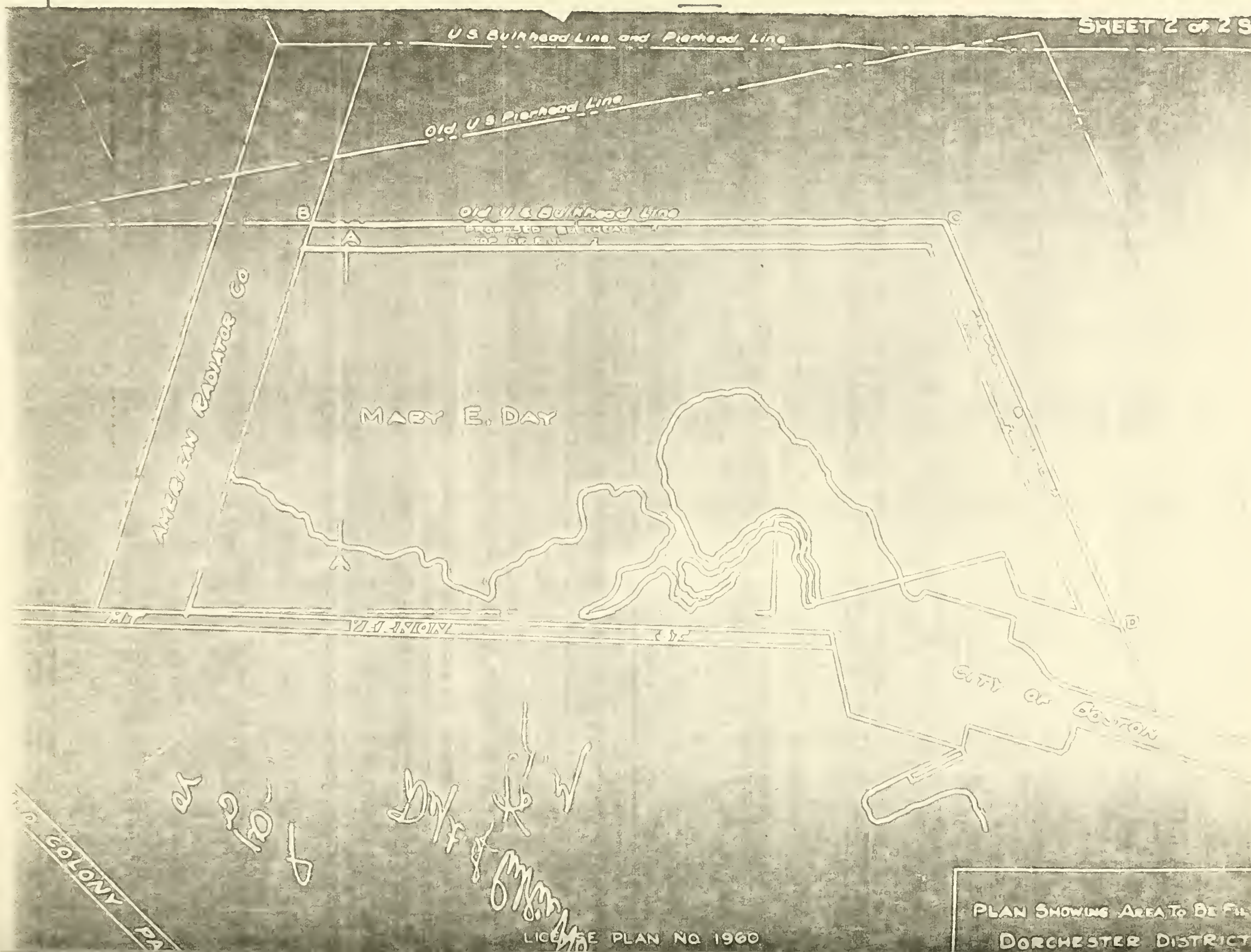
~~Boston,~~

~~Approved by the Governor and Council.~~

~~*Executive Secretary.*~~



SHEET 1 OF 2 SHEETS
OLD U.S. BULKHEAD LINE
CITY OF BOSTON PUMPING STA.
BOSTON CONSOLIDATED GAS CO.
SUB SKETCH SHOWING
GENERAL LOCATION OF WORK
Scale 1"=800'
APPROX. GR. 16.0
10"x18"
TO BE FILLED TO
APPROX. GR. 16.0
8"x10"
M.H.W.
8"x10"
M.L.W.
1¼" TIE ROD 8'-0" ¢ TO ¢
FLATS THRU A-A
SECTION THROUGH
PROPOSED BULKHEAD
DEPARTMENT OF PUBLIC WORKS


SHEET 2 of 2 SH
U S Bulkhead Line and Pierhead Line
Old U S Pierhead Line
Old U S Bulkhead Line
B
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D
AMERICAN RADIATOR CO
MARY E. DAY
VERNON ST
CITY OF BOSTON
COLONY PA
LICENSE PLAN No 1960
PLAN SHOWING AREA TO BE FI
DORCHESTER DISTRICT

APPENDIX J

MASSACHUSETTS COASTAL ZONE MANAGEMENT

CONSISTENCY DETERMINATION

COASTAL ZONE
MANAGEMENT

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

September 28, 1982

Mr. Richard B. Mertens
Environmental Review Officer
B.R.A.
1 City Hall Square
Boston, Massachusetts 02201

Re: Consistency Determination - UDAG Application
Columbia Point Multi Use Development Project

Dear Mr. Mertens:

The Massachusetts Coastal Zone Management Office has completed it's consistency review of the HUD application for UDAG funds to assist in the implementation of the Columbia Point Multi Use Development Project, pursuant to 15 CFR 930.90 - 100, Procedures in Event of Federal Financial Assistance to State and Local Governments. We concur that the "concept" of this proposal is consistent with our program policies. Policy 27, which encourages the revitalization and enhancement of existing development centers in the coastal zone through federal financial support for residential and commercial development is especially relevant to this proposal.

While this conceptual concurrence allows the B.R.A. to receive federal funding CZM will conduct a detailed review of Phases 1 and II of this development plan. Our detailed review will be concurrent with the MEPA review required for both phases.

We suggest that you submit a consistency certification for Phase I as soon as possible. A sample certification and summary of our policies is enclosed for your information. Feel free to contact Marianne Connolly of my staff at 727-9530 if you have any questions or need additional information.

Sincerely,

Richard F. Delaney

Richard F. Delaney
Director

RFD/MC:dn
Enclosure

cc: Dave Shepardson, MEPA Office

APPENDIX K

STATE COMPREHENSIVE

OUTDOOR RECREATION PLAN

Supply

- Approximately 2,400 sites in Massachusetts include intensive recreation facilities, of which 1,574 are less than 10 acres in size.
- One-third of the intensive recreation areas are located in SCORP Region VIII.
- Two-thirds of the 1,606 general recreation areas are non-urban and under 100 acres.
- The majority of natural areas, as classified by the inventory classification system, are located in Region VIII and are less than 1,000 acres in size.
- Metropolitan Boston contains over one-half of all historic/cultural sites indentified in the inventory.
- The region with the most recreation acreage is Berkshire.
- In terms of acreage/1,000 population, Nantucket leads the regions.
- The distribution of recreation facilities for the four most popular activities closely parallel the population distribution.
- Two hundred and eighteen miles of public beach frontage exist in Massachusetts.
- The highest concentration of all recreation facilities is found in Boston SMSA.
- The Merrimack Valley, Lower Pioneer Valley, Metropolitan Boston, and Old Colony Regions have the highest proportion of recreation facilities serviced by public transportation.
- Ten percent or less of the facility acreage in each region is barrier free.
- The Department of Environmental Management is the largest land-holding agency in the Commonwealth, administering 231,084 acres.
- Five hundred and ten sites in Massachusetts are listed on the National Register of Historic Places.
- The Massachusetts Natural Areas and Landscape Survey identified a total of 566 exceptional natural and cultural landscape features.

Demand

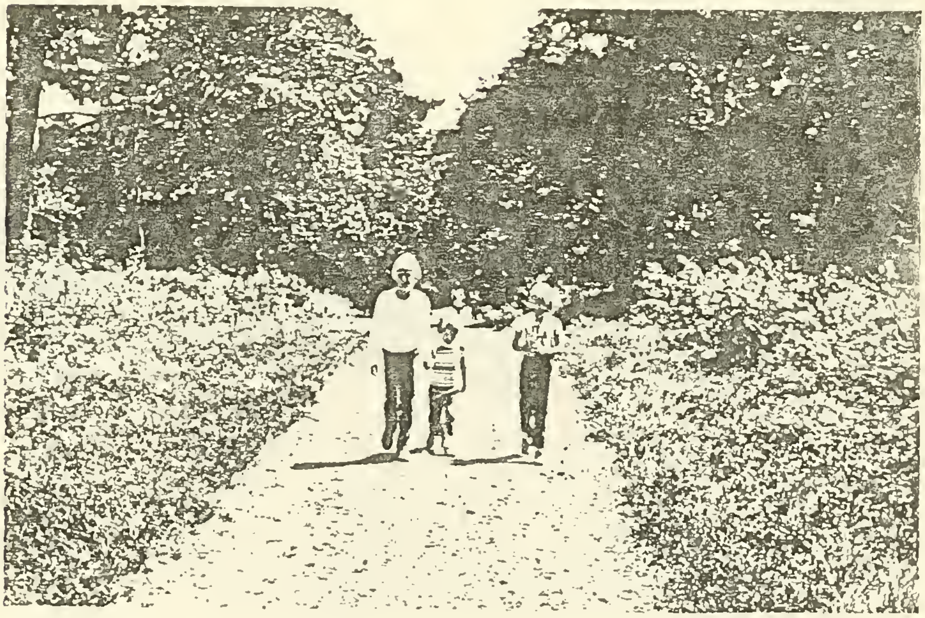
- Three most popular activities statewide are bicycling, nature walking and pool swimming.
- Ice skating is the most popular winter activity and bicycling is most popular for the summer.
- Males participate in outdoor recreation activities at a higher rate than females.
- Participation rates increase with income and decrease with age.
- Most activities have a one to four hour duration, occur on weekend days, and attract group participation.
- The four most western regions prefer picnicking to any other outdoor recreation activity, while both pool and non-pool swimming are preferred in the remaining nine regions.
- Demand for 5 of the 6 most popular activities will increase from 1977 to 2000.
- The three activities with the highest projected growth are trailer camping, pool swimming and golf.
- The most limiting factor to increased participation in outdoor recreation activities is time.
- Transportation and equipment costs and societal acceptance are the most limiting factors for the handicapped.

Needs

- The activities showing the highest capacity in the Commonwealth as a whole are non-pool swimming followed by ice skating and nature walking.
- Nature walking and bicycling, two of the most popular activities, show the most significant deficit of facilities statewide.
- A surplus of hunting facilities exist in Massachusetts. The majority of these facilities are located in the western most part of the state, while a substantial part of the demand occurs in eastern regions.
- The activity showing the greatest increase in facilities needs through the year 2000 is nature walking, with picnicking a close second.
- The Cape Cod, Metropolitan Boston and Berkshire Regions show the largest number of critical needs.

Actions

- Capital investment programmed for acquisition and development of recreation facilities and open space in the Commonwealth totals approximately $163.5 million over the next five fiscal years (1978 through 1982).
- During this five year period, the Commonwealth is expected to gain a total of 21,616 land and water acres for open space and outdoor recreation programs.
- Total investment for acquisition is estimated at $43.7 million.
- The cost of all development projects is expected to be more than triple the amount intended for acquisition.



World's End, Hingham

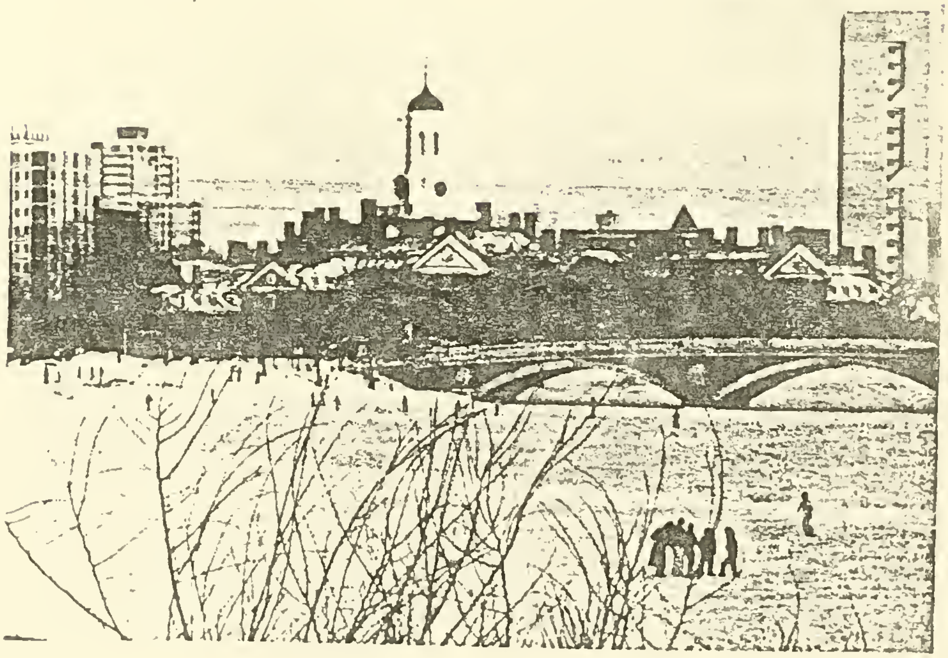
- Private conservation agencies carry out an important function in acquiring and protecting wildlife, cultural and natural areas.
- Preservation of open space and unique ecological sites are top priority actions for a majority of the Regional Planning Agencies.
- The source of financial and technical assistance is the government.
- Major sources of financial aid and technical assistance to recreation providers are: the federal Outdoor Recreation Coordination and Technical Assistance Program; the federal Land and Water Conservation Fund; Massachusetts Self-Help Fund; and Watershed Protection and Flood Prevention Program; and the Massachusetts Historical Commission's National Register Grants-In-Aid Programs.

Policies

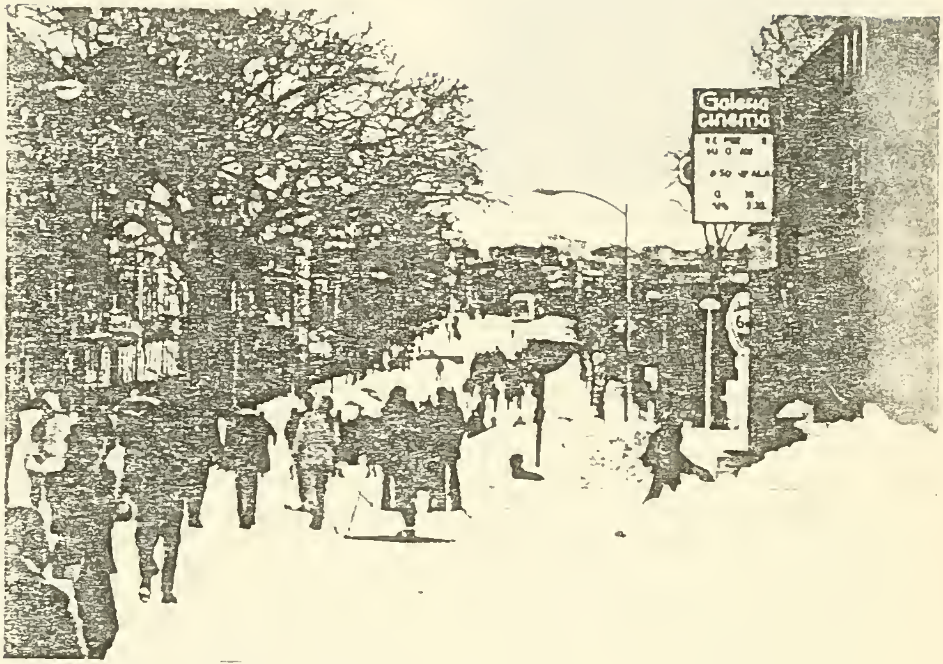
1. High priority funding assistance for local conservation/recreation projects meeting urban needs; DEM and MDC not to undertake local projects.
2. High priority acquisition, development and funding assistance for DEM and MDC regional park and conservation projects which are readily accessible to metropolitan residents, and/or preserve unique natural areas.
3. High priority development and funding assistance for projects which support urban revitalization efforts.
4. DEM to undertake study of its role in developing and managing urban Heritage parks.
5. Commonwealth to systematically identify and protect unique, diverse and endangered natural and cultural areas; priority funding for projects which preserve designated areas.
6. Commonwealth to develop and implement programs designed to identify and protect entire natural resources (e.g., watersheds, mountain ranges, coastal ecosystems, etc.).
7. Commonwealth to undertake and provide priority funding assistance for conservation/recreation projects in high growth areas accessible to metropolitan residents.
8. Commonwealth to initiate programs to assist cities and towns in preparation of local open space plans which shall be basis for state funding decisions in localities; special attention to high-growth areas.
9. Commonwealth to develop programs to improve access to recreation facilities for urban, elderly, poor, other special needs groups.
10. Commonwealth to initiate programs to improve public awareness of recreation opportunities with special attention to urban, special needs groups.
11. Commonwealth to implement public participation programs and continue coordination efforts.

Continuing Planning

1. *Modification of LWCF, Self-Help, Urban Self-Help Project Selection Systems; Review of Local Open Space Plans.* Analysis of past allocations of these funds will be conducted to determine if changes in selection systems are required to implement SCORP policies; if required, selection systems will be redesigned and monitored periodically.
2. *DEM Capital Outlay Planning.* Development of a capital outlay plan and project selection system for DEM; designed to select projects which will implement SCORP policies.
3. *Management Information System.* Completion of development of a Management Information System for data relating to open space resources, recreation needs and associated expenditures; data and reports to be made available to State, Local and other agencies.
4. *State Trails System.* Development of a comprehensive trails plan for the Commonwealth.
5. *Demand Modeling and Estimation.* Continued research concerning recreational demand in Massachusetts, particularly for special needs groups; development of new predictive methods.
6. *Recreation Access/Special Population Programs.* Development of programs to improve access for special needs groups (urban, minority, low-income, elderly, etc.) to recreation facilities; development of publications and signage systems designed to improve public awareness of available opportunities.



7. *Heritage Park Feasibility Study.* A study of the costs and feasibility of developing new Heritage parks; preparation of criteria to select projects, and a request for proposals for potential Heritage Park Projects.
8. *Massachusetts Heritage Program.* Development of a program to identify and protect unique natural and cultural resources in Massachusetts.
9. *Natural Resource System Protection.* Investigation of techniques which might be used to protect large-scale natural resource systems (including such features as watersheds, islands, coastal ecosystems, mountains, etc.)
10. *Coastal Facility Acquisition and Development Opportunities.* Building upon CZM plan, identification of coastal conservation/recreation sites with greatest feasibility for (and potential public benefits from) public acquisition by DEM, localities or other conservation/recreation agencies.
11. *Water Quality Improvements/Advanced Park Acquisition.* Based on regional 208 water quality plans and Scenic River inventory, identification of major acquisition opportunities where expected water quality improvements will make acquisition desirable for conservation/recreation projects.
12. *Local and Regional Planning and Public Participation.* DEM will work with regional planning agencies and other conservation/recreation groups to generate local participation in SCORP projects, and provide limited assistance to cities and towns designed to bring local open space plans and funding requests into line with SCORP policies.
13. *Urban Recreation Case Studies.* Preparation of case studies in several urban neighborhoods around the Commonwealth, focusing on maintenance and security issues, unmet recreational needs.
14. *Conservation/Recreation Land Acquisition Cost Study.* DEM will conduct a study to determine the cost effectiveness of advanced acquisition of low cost land in more remote areas as opposed to acquisition of more costly land with immediate public benefit.



Introduction

The SCORP Policy Statement and Implementation Program constitute the most significant section of the Plan, and are the product of more than a year of research and discussion involving both State officials, private individuals, and agencies with concerns in the recreation and conservation field in Massachusetts.

The purpose of this section is to clearly state the Commonwealth's priorities both for the allocation of available recreation/conservation funds, and for the use of staff resources in those state agencies with responsibilities in this field.

Each policy statement is tied directly with an implementation strategy which defines the steps necessary to effect the policy recommendations. These measures will be carried out as expeditiously as possible during the Continuing Planning period (1978-82), and annual reports on the status of implementation measures will be made during during this period.

The policies are organized into five subject areas, each one addressing critical recreation/conservation needs of the Commonwealth's citizens and communities:

I Urban Metropolitan Needs and the Commonwealth's Role
II Natural Area Identification and Protection
III Growth Policy/Local Needs
IV Public Accessibility and Awareness
V Public Participation in SCORP Planning

In order to ensure that SCORP policies provide the framework for the distribution of the LWCF, Self Help, and Urban Self Help, the definition of "urban" used for developing the policies was that of the relevant legislation. For a more detailed understanding of how the policies affect the 351 communities of the Commonwealth, refer to Appendix 5 which contains definitions of important terms and concepts mentioned in the policies.

I. Urban/Metropolitan Needs and the Commonwealth's Role

The Commonwealth has over the past three years re-directed its programs to meet pressing needs of the urban core communities; the intent has been to revitalize the centers and improve their economic and social viability. Great strides have been made to target state recreational funds and programs to meet urban recreation needs, and to serve as catalysts for other public and private revitalization efforts. These efforts have begun to show results; some urban communities are now stabilizing or showing new signs of vitality. The need remains, however, to continue public and private investments including recreation and open space programs to insure that this trend continues. Continued attention to community-based urban recreation programs remains a high priority for the Commonwealth. There is a need, therefore, to channel funds and direct programs to acquire, develop or restore those facilities which are located in or are accessible to core communities.

It should be recognized, however, that certain recreational needs of urban residents can only be met through the development of regional park and conservation facilities, often requiring extensive acreage in outlying locations. Urban residents appear to show continued or increased interest in such activities as hiking, nature walking, non-pool swimming and cross-country skiing which are best accommodated in such regional facilities.

Policy 1:

The Commonwealth recognizes that important local needs exist for acquisition, development and restoration of urban park and conservation lands. Projects addressing these needs shall receive priority consideration for state and federal funding assistance. Projects designed to meet local needs shall be locally developed and managed.

Implementation

Priority considerations for Land and Water Conservation Funds shall be given to local urban park and conservation acquisition, development or rehabilitation efforts. The Land and Water Conservation Fund Project Selection system will be revised to insure the implementation of this policy.

Palmer's Island in historic New Bedford harbor

The new Urban Self-Help program (projected for S5 million in FY 1979) will be used exclusively for acquisition or urban park areas. This fund may be used in conjunction with Land and Water funds to provide 90% State-Federal matching share for critical urban park projects.

Self-Help funds could be utilized for urban conservation land acquisition to the extent that Land and Water and Urban Self-Help funds do not meet this need. The new Self-Help project selection system will be monitored during fiscal year 1978 to determine whether it meets this policy objective, and will be modified accordingly if required.

Policy 2:

The acquisition, development and restoration of regional parks and conservation areas shall be the primary responsibility of the Department of Environmental Management and the Metropolitan District Commission. Regional parks and conservation projects shall be readily accessible to metropolitan residents, preserve unique natural areas for public benefit, and/or meet critical recreation needs of urban and metropolitan residents. Regional projects undertaken by state agencies and local projects which meet regional needs shall receive priority consideration for applicable state and federal funding.

Implementation

Land and Water funds will be made available for State and municipal projects which meet the criteria outlined in this policy. Self-Help funds will also be made available for municipal projects of this type.

DEM and MDC will investigate opportunities to acquire and develop new regional park facilities or rehabilitate existing facilities meeting the criteria outlined in this policy. The SCORP staff will work with the regional planning agencies, other conservation/ recreation agencies, and the Massachusetts Association of Conservation Commissions during 1978 and 1979 to identify potential sites and projects. Capital outlay requests for high priority projects will be prepared for anticipated funding in fiscal year 1980 and 1981. Multiple use arrangements involving watershed and other public lands will be investigated where this would meet critical open space, recreation or conservation needs, and would not conflict with the primary functions of these lands.

Policy 3:

Those urban park projects which are capable of inducing or enhancing other public or private investments in urban core communities shall be high priority activities for funding and/or development. Projects which are supportive of other revitalization activities, and which are part of a concerted revitalization program, shall also be high priority activities.

Implementation

The Land and Water Fund project selection system will be modified to assign extra points to projects which meet the criteria. Use of Community Development Block Grants or Urban Development Action Grants, as the matching share for these projects will be encouraged. State and MDC park projects in core communities which have community development potential will be assigned a higher funding priority.

Policy 4:

The Commonwealth shall carefully determine its role in developing and managing urban state parks and state heritage parks.

Implementation

The SCORP staff shall undertake, with the assistance of the Office of State Planning and Executive Office of Environmental Affairs, a study of the Urban State Park issue, to include an examination of criteria for their development, projections of costs and benefits, and identification of potential sites. The study will be completed by Summer 1978, and will recommend whether and where to proceed with new park developments. Assuming a decision to proceed with new Urban State Park projects, capital outlay requests would be made for fiscal year 1980.

II. Natural Area Identification and Preservation

The 1973 and 1976 SCORPs recommended that unique and endangered natural and ecological areas be protected and made available for appropriate public use.

Significant progress has been made in identifying and protecting such critical areas. At the state level, DEM has proceeded with extensive acquisition on the Holyoke Range, but has been delayed on the South Cape Beach project by the on-going Wampanoag Indian lawsuit. DEM has also begun to identify unique ecological areas within its forest and parks system and has designated its first and second such areas. DEM's Wetlands Restrictions and Scenic Rivers Programs have inventoried and assigned priorities to preservation needs for critical wetlands and watersheds and are proceeding with protection programs. The Massachusetts Coastal Zone Management plan has identified beaches, estuaries, saltmarshes and other features requiring protective measures.

At the local level, the City of Boston has identified natural areas within the City through its Urban Wilds program, and is now proceeding with programs to protect these areas. This program may become a model for other cities.

Major obstacles remain, however, in identifying and protecting natural and cultural areas and natural resource systems. With the exception of the 1972 Massachusetts Landscape and Natural Areas Survey (which is both incomplete and outdated), no systematic effort has been made to classify or protect the full range of these features in Massachusetts. Of equal importance is the need to develop a means to protect and manage entire natural resource systems; the traditional park management approach is not adequate to meet threats to the integrity of entire watersheds, mountain ranges, coastal ecosystems and other resources, particularly where ownership is fragmented between public, private and institutional holdings.

Policy 5:

The Commonwealth shall systematically identify and protect unique diverse and endangered natural and cultural areas. Priority consideration for state and federal funding, and state capital outlay funds shall be assigned to projects which preserve these features.

Implementation

Massachusetts Heritage Program: The Department of Environmental Management will undertake an ongoing Massachusetts Heritage Program designed to identify, classify and protect unique and diverse natural features and habitats and important cultural resources in the Commonwealth. Beginning in June 1978, DEM will contract over an 18 month period with the Nature Conservancy to design and implement this program, with protection of the identified sites to be carried out via fee and less-than fee acquisition, MEPA and A-95 review processes, and other means.

Land and Water Conservation Fund and State Self-Help Programs: Project selection systems for these

programs will be modified to provide additional priority for acquisition of sites identified by the Massachusetts Heritage Program. Interim criteria will be developed by DEM and Conservation Services to permit implementation of this recommendation for fiscal year 1979 funding allocation.

Policy 6:

The Commonwealth shall develop and implement a consistent set of programs designed to identify, protect and enhance entire natural resource systems, such as coastal beaches and marshes, watersheds, forests and mountain ranges.

Implementation

DEM will identify and classify natural resource systems through the Massachusetts Heritage Program and through technical assistance from the Trustees of Reservations, Massachusetts Audubon and the Regional Planning Agencies. The Commonwealth will develop and undertake programs to protect and enhance these natural resource systems. Existing programs, such as the Scenic Rivers, wetlands restrictions and MEPA review programs will continue to be pursued vigorously; other activities such as the Scenic Mountains program and critical area designation and CZM and 208 plans will be implemented to provide consistent protection of designated resource areas.

The Commonwealth will investigate innovative approaches to protect these areas. These will include possible development of a State Register of Natural Landmarks, and development of comprehensive management plans to guide state, local, private and institutional activities in designated areas. The Commonwealth will also investigate the feasibility of developing new legislation to establish special commissions similar to the Martha's Vineyard Commission to manage public and private activities in designated conservation and recreation areas.

Castle Hill, Ipswich

III. Growth Policy/Local Needs

The past twenty years have witnessed rapid unplanned metropolitan growth in the Commonwealth, characterized by sprawling suburban development and the decline of the urban core cities. These developments now threaten not only the economic vitality and liveability of the older cities, but also the quality of life of all metropolitan residents.

Unplanned growth has led to the loss of valuable recreational open space sites in close proximity to urban and suburban areas; remaining available sites are either under strong development pressures, or are inaccessible to metropolitan residents.

The Commonwealth has recently completed a Growth Policy Report which calls for the redirection of metropolitan growth into urban centers, and more coordinated growth in outlying areas. Open space planning and park development can support these goals through selective siting of new regional facilities where rapid peripheral growth threatens irreplaceable natural resources, and through effective coordination with other environmental programs, such as the Coastal Zone Management and 208 planning programs.

The Commonwealth recognizes that cities and towns have the prime responsibility to identify and plan for local recreation needs; it is appropriate therefore that localities continue to maintain control over local planning for these needs. The Commonwealth does, however, have a responsibility to assist localities by providing information and programs required to develop local open space plans, and to provide state and federal funds to assist local projects.

Policy 7:

The Commonwealth shall support and encourage the protection of open space and recreation/conservation lands in high growth areas which are accessible to metropolitan residents. Preservation activities in these areas shall be a priority for state and federal funding assistance over similar efforts in other areas of the Commonwealth which are not likely to succumb to development pressures and are relatively inaccessible to metropolitan residents.

Implementation

Open space acquisition proposals in high-growth areas will receive priority in both state capital outlay and Land and Water funding decisions.

The Self-Help and Land and Water Fund project selection systems will be monitored during 1978 to determine whether adequate provision is made for funding of key projects implementing this policy. Adjustments will be made in these selection systems if required.

Amendments to Chapter 61 will be introduced to encourage the preser-

vation of agricultural and forestry lands in and adjacent to metropolitan areas by permitting higher-valued properties to qualify for this tax abatement program.

The Scenic Rivers and Wetlands Restriction programs will assign a priority to the protection of these natural resources and open space areas which are threatened by suburban growth.

The identification and acquisition of metropolitan links in the State Trail System will receive highest priority to insure that direct access from metropolitan areas is not precluded by other development.

DEM will work with the Massachusetts Historical Commission to identify important cultural and historic areas which may be adversely affected by metropolitan growth and which have recreational potential.

Policy 8:

The Commonwealth shall initiate programs to help cities and towns identify their recreation/natural areas preservation needs and prepare local open space plans. Local open space plans shall form the basis for local and state decisions regarding state and federal funding assistance to local projects. Special efforts shall be made to assist urban and/or high growth communities and those communities which have not previously received state and federal funds.

Implementation

DEM will work with Regional Planning Agencies and the conservation/recreation organizations to assist cities and towns in the preparation of local open space plans and state and federal funding proposals. Local planning requirements will be reviewed to insure that these plans reflect a balanced focus on meeting pressing recreation needs and on preserving important natural areas.

IV. Public Accessibility and Awareness

The Commonwealth currently owns sites throughout the state that are available for recreation use. Many are underutilized for three primary reasons: first, these sites are not accessible by public transportation; second, public awareness of available opportunities is limited by a lack of adequate information; third, structural barriers prevent the use of some recreation sites by handicapped and elderly persons.

Policy 9:

The Commonwealth shall develop programs to improve access to recreation facilities for the disadvantaged, aged, handicapped and urban residents who do not own automobiles. Improvements shall be made at state-owned recreation facilities to enhance and increase recreational use by these groups.

Implementation

At the conclusion of the SCORP recreation access study, feasible and cost-effective transportation projects will be identified by DEM and funding requests will be made. When feasible projects are identified, a proposal for an Urban Mass Transit Administration Demonstration Grant will be submitted for funding in fiscal year 1979 or 1980.

DEM will support a $3 million bonding authorization requested for fiscal year 1979, which will be used to remove architectural barriers in DEM facilities. A special advisory Committee, made up of persons and organizations representing handicapped persons, will be established to assist DEM in programming and designing these improvements, and to advise DEM regarding subsequent barrier removal activities.

Land and Water Conservation Fund and Capital Outlay project selection systems will be modified to provide extra priority for projects which remove architectural barriers from the existing facilities.

Policy 10:

The Commonwealth shall initiate programs to improve public awareness of recreation opportunities; efforts shall be made to reach urban residents, special needs groups and the general public in order to maximize public use of available resources.

Implementation

The Commonwealth will undertake a program of highway and mass transit signage and informational publications designed to reach and inform the general public as well as urban and special needs groups; if required these will be available in languages other than English. Distribution will be handled through city halls, urban recreation departments and other means.

V. Public Participation in SCORP Planning

Major efforts have been made in the past year to open the SCORP planning process to public scrutiny and comment. As the Commonwealth moves into a SCORP continuing planning program, continued and intensified involvement by individuals, concerned agencies, and cities and towns will be requested to insure that the process reflects public needs. Continued effort to coordinate SCORP activities with other federal, state and regional planning efforts will be required to maximize the utility of SCORP planning programs.

Policy 11:

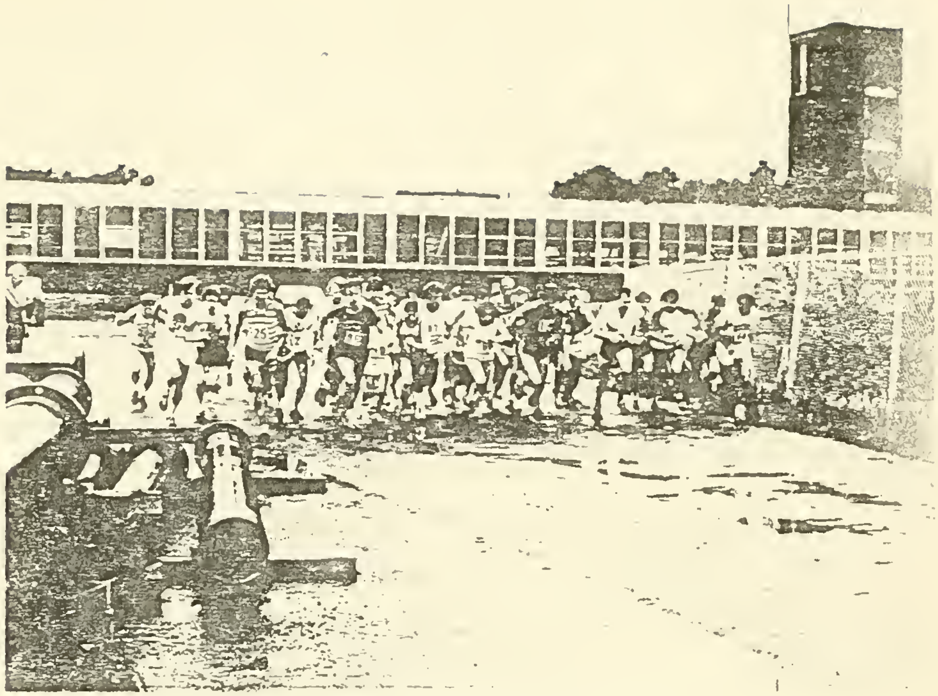
The Commonwealth shall continue to implement programs to open the SCORP Planning Process to participation by the general public, recreation providers and other agencies with programs or facilities which affect, or are affected by SCORP planning. SCORP planning shall also be closely coordinated with other federal, statewide and regional comprehensive planning programs.

Implementation

DEM will continue to work closely with the SCORP Technical Advisory Committee during the continuing planning program. The TAC members represent a broad range of interests and agencies (both private and public) with concerns in the conservation and recreation field. (Members and their agency affiliations are listed in Appendix 6). The TAC will oversee the progress of each continuing planning project, and will also periodically review progress in implementing SCORP policies.

In addition, through the Local and Regional Planning and Public Participation project, a major effort will be made to involve regional planning agencies, other conservation and recreation agencies, and cities and towns in the development and implementations of SCORP policies and projects.

Efforts will also be made by the SCORP staff to continue coordination with other federal, statewide and regional planning programs, such as Coastal Zone Management, 208 regional waste-water planning, State Growth Policy planning, HUD 701 land use planning, etc.



The traditional Saturday morning road race at Fresh Pond, Cambridge

APPENDIX L

AIR QUALITY ANALYSIS

The following is a summary of the inputs to the Air Quality analysis:

WORKSHEET 2 LINE SOURCE EMISSION RATE COMPUTATION

- Step 5: Emission rates obtained from MOBILE-2 program. Vehicle mix is from MRMV records. Variables used include:

  T = 33°F
  50/10/50 mix for 1-hour; default values for 8-hours
  Low altitude
  1984 & 87 Base years

- Step 6.3 thru 6.7: Capacities obtained using BRA methodology w/ results included hereinafter.
- Step 15: EF = 0.153 (1984)
  = 0.116 (1987)
- Step 17a: Line 16 corrected for the year 1987 by using the formula:

$$\text{Line 17a} = \text{Line 16} \times \frac{\text{Emissions factor for 5 MPH}}{182.4}$$

$$= \text{Line 16} \times \frac{158.63}{182.4}$$

WORKSHEET 5 INTERSECTION DISPERSION ANALYSIS

LINE #	SYMBOL	VARIABLE USED
1	SC	D
2	u	1.0 for 1-hour 1.3 for 8-hour
3	θ	6°/84°
4-6	X, Yu, Yd	Closest receptor chosen for each intersection
7	σ_{z_0}	5.0m
8 & 9	Q_e, Q_f	From Worksheet 2

MOBILE-3

EMISSIONS OUTPUT

1984 [illegible] ASS VALUES 5/13/85

I/M PROGRAM SELECTION:

START YEAR (JAN 1): 1983
PRE-1981 MYR STRINGENCY RATE: 15%
MECHANIC TRAINING PROGRAM?: NO
FIRST MODEL YEAR COVERED: 1970
LAST MODEL YEAR COVERED: 2020
VEHICLE TYPES COVERED: LDGV, LDGT1, LDGT2
TEST TYPE: IDLE
1981 & LATER MYR TEST CUTPOINTS: 1.2% ICO / 220 PPM IHC

NOTE: NON-METH HC EMISSION FACTORS INCLUDE EVAPORATIVE HC EMISSION FACTORS.

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1984 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 33.0 (F)
ANTI-TAM. PROGRAM: NO OPERATING MODE: 20.6 / 27.3 / 20.6

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
VEH. SPD.:	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	
VMT MIX:	.659	.136	.092		.036	.018	.005	.047	.007	
COMPOSITE EMISSION FACTORS (GM/MILE)										
NON-METH HC:	13.34	19.88	27.18	22.82	35.83	.79	1.40	10.25	19.49	15.91
EXHST CO:	159.99	227.36	342.40	257.62	539.87	3.47	4.56	39.65	135.09	186.26
EXHST NOX:	2.91	3.95	4.77	4.28	5.86	2.26	2.76	35.64	.99	4.85
HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)										
NON-METH HC:	.52	.47	.61	.53	.78	.03	.11	.36	.87	.52
IDLE CO:	7.93	7.22	7.90	7.49	9.24	.18	.35	.97	2.66	7.33
IDLE NOX:	.15	.07	.07	.07	.06	.18	.37	.92	.04	.18

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1984 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 33.0 (F)
ANTI-TAM. PROGRAM: NO OPERATING MODE: 20.6 / 27.3 / 20.6

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
VEH. SPD.:	10.0	10.0	10.0		10.0	10.0	10.0	10.0	10.0	
VMT MIX:	.659	.136	.092		.036	.018	.005	.047	.007	
COMPOSITE EMISSION FACTORS (GM/MILE)										
NON-METH HC:	8.28	12.38	16.33	13.97	26.13	.62	1.10	8.05	11.48	10.05
EXHST CO:	91.42	131.43	162.77	144.07	359.18	2.39	3.14	27.34	64.81	107.66
EXHST NOX:	2.76	3.74	4.60	4.09	6.16	1.87	2.29	29.57	.89	4.42
HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)										
NON-METH HC:	.52	.47	.61	.53	.78	.03	.11	.36	.87	.52

IDLE CO:	7.93	7.22	7.90	7.49	9.24	.18	.35	.97	2.66	7.33
IDLE NOX:	.18	.07	.07	.07	.06	.18	.37	.92	.04	.18

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1984 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 33.0 (F)
ANTI-TAM. PROGRAM: NO OPERATING MODE: 20.6 / 27.3 / 20.6

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
VEH. SPD.:	15.0	15.0	15.0		15.0	15.0	15.0	15.0	15.0	
VMT MIX:	.659	.136	.072		.036	.018	.005	.047	.007	
COMPOSITE EMISSION FACTORS (GM / MILE)										
[illegible] HC:	6.31	9.46	12.23	10.54	20.29	.50	.88	6.46	8.77	7.67
EXHST CO:	65.37	94.78	111.18	101.39	252.48	1.73	2.27	19.73	42.00	76.76
EXHST NOX:	2.74	3.70	4.55	4.05	6.45	1.61	1.97	25.42	.91	4.21
HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)										
IDLE HC:	.52	.47	.61	.53	.78	.03	.11	.36	.87	.52
IDLE CO:	7.93	7.22	7.90	7.49	9.24	.18	.35	.97	2.66	7.33
IDLE NOX:	.18	.07	.07	.07	.06	.18	.37	.92	.04	.18

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1984 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 33.0 (F)
ANTI-TAM. PROGRAM: NO OPERATING MODE: 20.6 / 27.3 / 20.6

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
VEH. SPD.:	20.0	20.0	20.0		20.0	20.0	20.0	20.0	20.0	
VMT MIX:	.659	.136	.072		.036	.018	.005	.047	.007	
COMPOSITE EMISSION FACTORS (GM / MILE)										
[illegible] HC:	5.23	7.73	10.07	8.66	16.60	.41	.72	5.30	7.53	6.33
EXHST CO:	51.59	73.98	83.75	77.86	187.51	1.30	1.71	14.90	31.57	59.37
EXHST NOX:	2.80	3.76	4.59	4.10	6.75	1.43	1.75	22.64	1.00	4.13
HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)										
IDLE HC:	.52	.47	.61	.53	.78	.03	.11	.36	.87	.52
IDLE CO:	7.93	7.22	7.90	7.49	9.24	.18	.35	.97	2.66	7.33
IDLE NOX:	.18	.07	.07	.07	.06	.18	.37	.92	.04	.18

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1984 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 33.0 (F)
ANTI-TAM. PROGRAM: NO OPERATING MODE: 20.6 / 27.3 / 20.6

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
VEH. SPD.:	25.0	25.0	25.0		25.0	25.0	25.0	25.0	25.0	

1234567890123456789012345678901234567890123456789012345678901234567890123456789

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
VMT MIX:	.659	.136	.092		.036	.018	.005	.047	.007	

COMPOSITE EMISSION FACTORS (GM/MILE)

	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
NO-MTH HC:	4.49	6.57	8.65	7.41	14.34	.34	.61	4.44	6.76	5.42
EXHST CO:	41.26	58.58	65.50	61.37	147.13	1.03	1.35	11.78	25.25	47.17
EXHST NOX:	2.89	3.87	4.67	4.19	7.05	1.32	1.62	20.89	1.10	4.14

HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)

	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
NM-ID HC:	.52	.47	.61	.53	.78	.03	.11	.36	.87	.52
IDLE CO:	7.93	7.22	7.90	7.49	9.24	.18	.35	.97	2.66	7.33
IDLE NOX:	.18	.07	.07	.07	.06	.18	.37	.92	.04	.18

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1984 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 33.0 (F)
ANTI-TAM. PROGRAM: NO OPERATING MODE: 20.6 / 27.3 / 20.6

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
VEH. SPD.:	30.0	30.0	30.0		30.0	30.0	30.0	30.0	30.0	
VMT MIX:	.659	.136	.092		.036	.018	.005	.047	.007	

COMPOSITE EMISSION FACTORS (GM/MILE)

	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
NO-MTH HC:	3.92	5.68	7.60	6.45	12.84	.29	.52	3.81	6.19	4.75
EXHST CO:	33.11	46.50	52.02	48.72	121.98	.85	1.12	9.74	20.71	37.89
EXHST NOX:	2.98	3.99	4.77	4.31	7.34	1.26	1.55	19.98	1.19	4.19

HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)

	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
NM-ID HC:	.52	.47	.61	.53	.78	.03	.11	.36	.87	.52
IDLE CO:	7.93	7.22	7.90	7.49	9.24	.18	.35	.97	2.66	7.33
IDLE NOX:	.18	.07	.07	.07	.06	.18	.37	.92	.04	.18

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1984 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 33.0 (F)
ANTI-TAM. PROGRAM: NO OPERATING MODE: 20.6 / 27.3 / 20.6

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
VEH. SPD.:	35.0	35.0	35.0		35.0	35.0	35.0	35.0	35.0	
VMT MIX:	.659	.136	.092		.036	.018	.005	.047	.007	

COMPOSITE EMISSION FACTORS (GM/MILE)

	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
NO-MTH HC:	3.50	5.02	6.81	5.74	11.84	.26	.46	3.34	5.74	4.24
EXHST CO:	26.94	37.44	42.01	39.28	106.84	.74	.97	8.43	17.34	31.04
EXHST NOX:	3.07	4.11	4.88	4.42	7.64	1.25	1.53	19.80	1.27	4.28

HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)

	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
NM-ID HC:	.52	.47	.61	.53	.78	.03	.11	.36	.87	.52
IDLE CO:	7.93	7.22	7.90	7.49	9.24	.18	.35	.97	2.66	7.33
IDLE NOX:	.18	.07	.07	.07	.06	.18	.37	.92	.04	.18

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1984 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 33.0 (F)
ANTI-TAM. PROGRAM: NO OPERATING MODE: 20.6 / 27.3 / 20.6

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL V
VEH. SPD.:	40.0	40.0	40.0		40.0	40.0	40.0	40.0	40.0	
VMT MIX:	.659	.136	.092		.036	.018	.005	.047	.007	
COMPOSITE EMISSION FACTORS (GM/MILE)										
O-MTH HC:	3.21	4.57	6.25	5.25	11.18	.23	.41	2.99	5.43	3.9
EXHST CO:	22.68	31.37	34.96	32.82	98.87	.67	.88	7.64	14.98	26.4
EXHST NOX:	3.16	4.24	5.00	4.55	7.94	1.29	1.57	20.32	1.32	4.4
HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)										
IM-ID HC:	.52	.47	.61	.53	.78	.03	.11	.36	.87	.5
IDLE CO:	7.93	7.22	7.90	7.49	9.24	.18	.35	.97	2.66	7.3
IDLE NOX:	.18	.07	.07	.07	.06	.18	.37	.92	.04	.1

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1984 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 33.0 (F)
ANTI-TAM. PROGRAM: NO OPERATING MODE: 20.6 / 27.3 / 20.6

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL V
VEH. SPD.:	45.0	45.0	45.0		45.0	45.0	45.0	45.0	45.0	
VMT MIX:	.659	.136	.092		.036	.018	.005	.047	.007	
COMPOSITE EMISSION FACTORS (GM/MILE)										
O-MTH HC:	3.03	4.29	5.89	4.93	10.75	.21	.37	2.74	5.24	3.6
EXHST CO:	20.09	27.86	30.35	28.87	96.67	.63	.83	7.24	13.47	23.7
EXHST NOX:	3.27	4.39	5.17	4.71	8.24	1.37	1.67	21.62	1.35	4.5
HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)										
IM-ID HC:	.52	.47	.61	.53	.78	.03	.11	.36	.87	.5
IDLE CO:	7.93	7.22	7.90	7.49	9.24	.18	.35	.97	2.66	7.3
IDLE NOX:	.18	.07	.07	.07	.06	.18	.37	.92	.04	.1

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS.

CAL. YEAR: 1984 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 33.0 (F)
ANTI-TAM. PROGRAM: NO OPERATING MODE: 20.6 / 27.3 / 20.6

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL V
VEH. SPD.:	50.0	50.0	50.0		50.0	50.0	50.0	50.0	50.0	
VMT MIX:	.659	.136	.092		.036	.018	.005	.047	.007	
COMPOSITE EMISSION FACTORS (GM/MILE)										
O-MTH HC:	2.91	4.11	5.65	4.73	10.48	.20	.35	2.56	5.15	3.5

HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)

EXHST CO:	18.46	25.83	27.34	26.44	99.87	.63	.83	7.19	12.49	22.20
EXHST NOX:	3.43	4.62	5.42	4.94	8.53	1.51	1.85	23.83	1.40	4.86

HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)

HM-ID HC:	.52	.47	.61	.53	.78	.03	.11	.36	.87	.52
IDLE CO:	7.93	7.22	7.90	7.49	9.24	.18	.35	.97	2.66	7.33
IDLE NOX:	.18	.07	.07	.07	.06	.18	.37	.92	.04	.18

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS,

CAL. YEAR: 1984 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 33.0 (F)
ANTI-TAM. PROGRAM: NO OPERATING MODE: 20.6 / 27.3 / 20.6

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
VEH. SPD.:	55.0	55.0	55.0		55.0	55.0	55.0	55.0	55.0	
VMT MIX:	.659	.136	.092		.036	.018	.005	.047	.007	

COMPOSITE EMISSION FACTORS (GM/MILE)

NO-MTH HC:	2.78	3.90	5.42	4.51	10.35	.19	.34	2.45	5.03	3.39
EXHST CO:	16.38	22.85	24.42	23.49	109.00	.65	.86	7.46	11.44	20.47
EXHST NOX:	3.69	4.99	5.80	5.31	8.83	1.72	2.11	27.21	1.51	5.30

HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)

HM-ID HC:	.52	.47	.61	.53	.78	.03	.11	.36	.87	.52
IDLE CO:	7.93	7.22	7.90	7.49	9.24	.18	.35	.97	2.66	7.33
IDLE NOX:	.18	.07	.07	.07	.06	.18	.37	.92	.04	.18

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS,

CAL. YEAR: 1984 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 33.0 (F)
ANTI-TAM. PROGRAM: NO OPERATING MODE: 50.0 / 10.0 / 50.0

VEH. TYPE:	LDGV	LDGT1	LDGT2	LDGT	HDGV	LDDV	LDDT	HDDV	MC	ALL VEH
VEH. SPD.:	5.0	5.0	5.0		5.0	5.0	5.0	5.0	5.0	
VMT MIX:	.659	.136	.092		.036	.018	.005	.047	.007	

COMPOSITE EMISSION FACTORS (GM/MILE)

NO-MTH HC:	20.74	29.83	40.82	34.26	35.83	.91	1.60	10.25	29.44	23.48
EXHST CO:	262.23	368.54	477.63	412.53	539.87	3.97	5.20	39.65	218.83	289.57
EXHST NOX:	3.04	4.17	4.90	4.46	5.86	2.31	2.89	35.64	.93	4.98

HOT STABILIZED IDLE EMISSION FACTORS (GM/MIN)

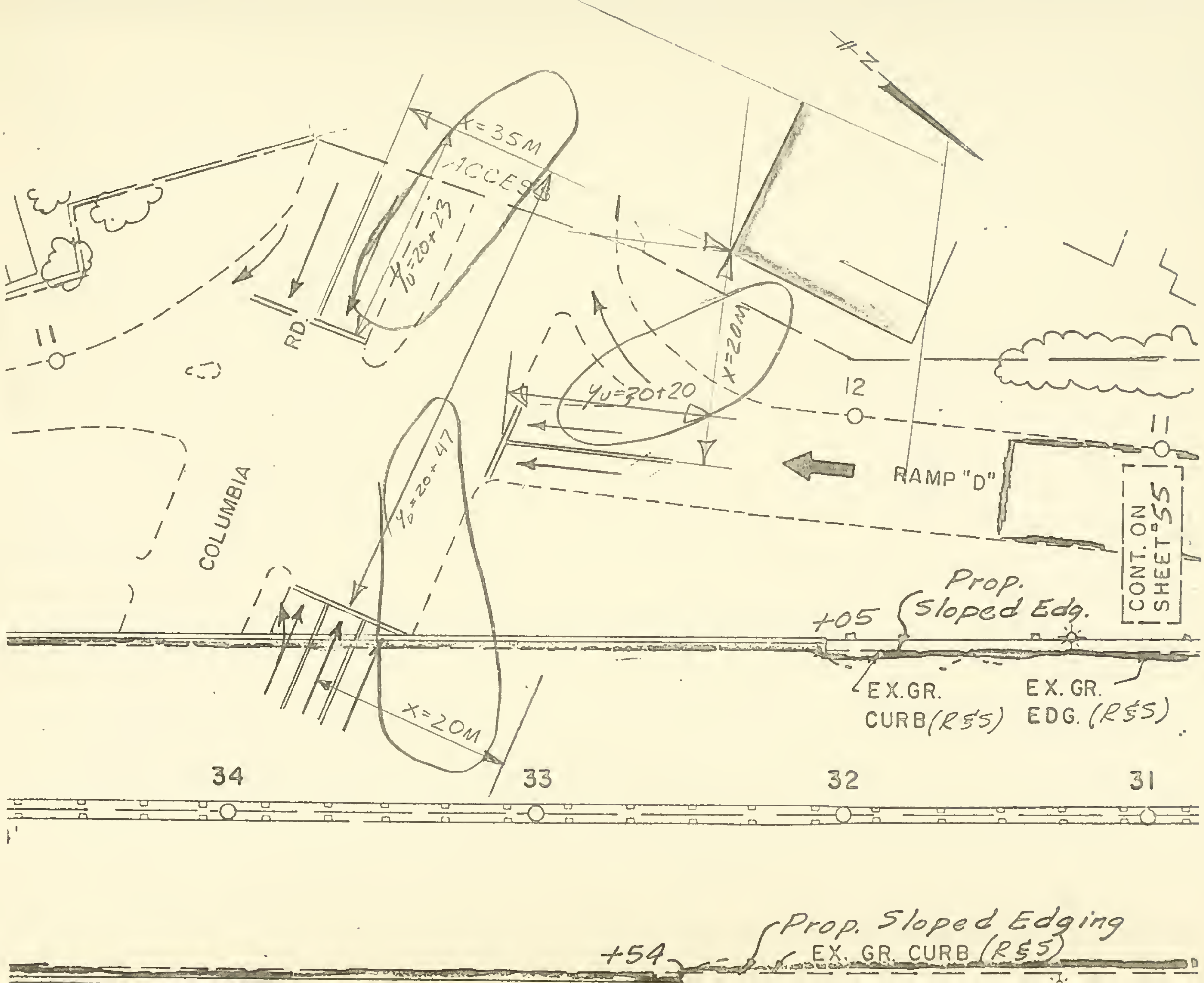
HM-ID HC:	.52	.47	.61	.53	.78	.03	.11	.36	.87	.52
IDLE CO:	7.93	7.22	7.90	7.49	9.24	.18	.35	.97	2.66	7.33
IDLE NOX:	.18	.07	.07	.07	.06	.18	.37	.92	.04	.18

USER SUPPLIED VEH REGISTRATION DISTRIBUTIONS,

CAL. YEAR: 1984 REGION: LOW ALTITUDE: 500. FT.
I/M PROGRAM: YES AMBIENT TEMP: 33.0 (F)

COLUMBIA RD./EXPRESSWAY

SOUTHBOUND OFF-RAMP


#2
X=35M
ACCESS
y_0=20+23
RD.
11
12
X=20M
y_U=20+20
RAMP "D"
CONT. ON SHEET 55
COLUMBIA
y_0=20+47
X=20M
+05
Prop. Sloped Edg.
EX.GR. CURB (R&S)
EX.GR. EDG. (R&S)
34
33
32
31
+54
Prop. Sloped Edging
EX. GR. CURB (R&S)

1984 EXISTING

INTERSECTION DATA FOR AIR QUALITY ANALYSIS - WORK SHEET

THE MEANING OF THE V/C RESULTS

V/C	IMPLICATIONS
0.70 and below......	No congestion expected
0.80................	Congestion very unlikely
0.90................	Some delays encountered; some congestion during peak events or bad weather
1.00................	Some congestion will be encountered during the peak hour
1.20 and above......	Congestion will extend beyond the peak hour unless traffic travels at other times, involves more transit/shared ride, or trips aren't made (less development; more building vacancies).

NOTES:

1. As described in NCHRP bulletin 187
2. LS = 1450 vph (NCHRP bulletin 187 LOS "E" range)
3. Generally $C_s = L_s \frac{V}{L}$ Cycle length (C_y) = seconds
4. G - cy ($\frac{L}{cms}$) where CMS is critical movement summary of NCHRP bulletin 187 = sum of critical L's
5. Proportioning cycle time according to largest L (÷CMS) for each phase adjusting for minimum greens necessary for pedestrians, etc.
6. $C = \frac{G}{C_y} C_s$

APPROACH

		A	B	C	D	E
APPROACH WIDTH	W					
PARKING	P					
LANES	M	2	3	2		
PHASE		P	P	Q		
HOURLY VOLUME	V	533	749	245		
CRITICAL LANE VOLUME (1)	L	682	689	98		
LANE CAPACITY/ HOUR GREEN (2)	L_s	1450	1450	1450		
APPROACH CAPACITY /HOUR GREEN (3)	C_s	1133	1576	3625		
DESIGN GREEN (4) (SECONDS)	G	-	84	16		
DESIGN GREEN/ CYCLE (5)	G/C_Y	.84	.84	.16		
APPROACH CAPACITY	C	952	1324	580		
VOLUME CAPACITY	V/C	0.56	0.57	0.42		

Project: Columbia Point

Intersection: Columbia Rd.

X-way SB off ramp

SHEET OF SHEETS DATE:

Comp by: MBC Chkd by:

1984 EXISTING

8 HOUR

Critical Movement Analysis

101

245

360

389

533

A

223

Identify / Phasing	1	2	3	4	Intersection Level of Service

Direction	Net Approach Volume	Lane Use Factor	Lane Volume
Columbia Pt (A)	533	.55	293
Columbia Rd. (B)	749	.40	300
X-way SB ramp (C)	245	.55	98
(D)			
(E)			

	A	B	C	D	E
Net Through Volume	293	300	98		
Unprotected Left-Turn	-	389	-		
Opposing Left-Turn Volume	389	-	-		
TOTAL	682	689	98		

Critical Movement Summation CMS

CMS =

CMS =

CMS = Vehicles

APPROACH LANES	LANE-USE FACTOR
1	1.00
2	0.55
3	0.40
4	0.30

INTERSECTION CAPACITY BY LEVEL OF SERVICE

LEVEL OF SERVICE	LIMITS OF CAPACITY (VPH) LOW	HIGH
A	0	900
B	901	1,050
C	1,051	1,200
D	1,201	1,350
E	1,351	1,500
F	(Special data)	1,500

X-way S.B. ramp
1984 EXISTING
8 HOUR

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION
(see instructions following)

Project No.: 463 Analyst: H. Chassé

Site: Columbia Point Date: 3/7/85

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	CE	CW	RS	
2	V_i	Demand volume (vph)	533	749	245	
3	C_i	Free-flow capacity (vph)	—	—	—	
4	S_i	Cruise speed (mph)	30	30	25	
5	Ef_i	Free-flow emissions (g/veh-m)	.024	.024	.029	
6.1	N_i	Number of lanes in approach i	2	3	2	
6.2	j	Signalized intersections phase identification	P	P	Q	
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	1133	1576	3625	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	533	749	245	
6.5	C_y	Signal cycle length (s)	100			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	84	84	16	
6.7	C_i	Capacity of approach i (vph)	952	1324	580	
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.30	0.30	0.90	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	4.44	6.24	6.13	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	1.27	1.30	0.73	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	11.4	10.1	13.7	
9	Rq_i	Average excess running time on approach (s/veh)	7.2	3.5	42.3	
10	Ea_i	emissions from acceleration (g/veh-m)	.10	.10	.11	
11	Ed_i	emissions from deceleration (g/veh-m)	.031	.031	.045	
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)	.0058	.0082	.0095	
13	Lad_i	Length of acceleration and deceleration (m)	80.5	80.5	55.9	
14	Le_i	Length over which excess emissions apply (m)	40	40	40	
15	Fs_i	Average idling emission rate (g/s)	.022	0.063	0.310	
16	Qe	Average emission rate (g/m-s)	.012	.015	.021	
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.011	.014	.019	
18	Qfc_i	Free-flow emission rate (g/s-m)	.004	.005	.002	

17a .012 .015 .021
– 17b .001 .001 .002
.011 .014 .019

Columbia ... 1
X-way S.B. ramp
1984 EXISTING
8 HOUR

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

PROJECT NO.: 463 ANALYST: M. Chasse
SITE: Colombia Point DATE: 3/8/85

LINE NO.	SYMBOL	INPUT/UNITS	TRAFFIC STREAM			
		BASIC INPUTS	CE	CW	RS	
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED ($m\ s^{-1}$)	1.	1.	1.	
3	θ	WIND-ROAD ANGLE (deg)	6°	6°	84°	
4	x	LATERAL DISTANCE (m)	35	20	20	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	43	77	40	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	32	167	216	
7	σ_{z_0}	INITIAL DISPERSION (m)	5.0	5.0	5.0	
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.011	.014	.019	
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.004	.005	.002	
9a		STREET CANYON? YES OR NO	NO	NO	NO	
		DISPERSION ANALYSIS				
10	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	405	590	140	
	Qf	ENTER LINE 9	x .004	x .005	x .002	x
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	1.6	3.0	0.3	
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	1.0	1.9	0.2	
13	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yu)	0	10	105	
	Qe	ENTER LINE 8	x .011	x .014	x .019	
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	0	0.1	2.0	
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷
15	χ	CO CONCENTRATION--"MAXIMUM QUEUE"	0	0.1	1.3	
16	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yd)	0	0	85	
	Qe	ENTER LINE 8	x .011	x .014	x .019	x
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	0	0	1.6	
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷
18	χ	CO CONCENTRATION--"IMAGINARY QUEUE"	- 0	- 0	- 1.0	-
19	χ	CO ($mg\ m^{-3}$) TOTAL	1.0	2.0	0.5	
20	χ	CO CONCENTRATION (ppm)--TOTAL	0.9	2.3	0.4	
		OPTIONAL z-CORRECTION (HEIGHTS OTHER THAN 1.0 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^3)				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

8 HOUR TOTAL = 3.6 + 1.5 = 5.1 ppm
1 HOUR TOTAL = 3.6(G.7) = 5.1 + 3.0 =
8.1 ppm

1990

INTERSECTION DATA FOR AIR QUALITY ANALYSIS - WORK SHEET

THE MEANING OF THE V/C RESULTS

V/C	IMPLICATIONS
0.70 and below......	No congestion expected
0.80................	Congestion very unlikely
0.90................	Some delays encountered; some congestion during peak events or bad weather
1.00................	Some congestion will be encountered during the peak hour
1.20 and above......	Congestion will extend beyond the peak hour unless traffic travels at other times, involves more transit/shared ride, or trips aren't made (less development; more building vacancies).

NOTES

1. As described in NCHRP bulletin 137
2. LS = 1450 vph (NCHRP bulletin 137 LOS "E" range)
3. Generally $C_s = L_s \frac{V}{L}$ cycle length (C_y) = seconds
4. $G = C_y \left(\frac{L}{CMS}\right)$ where CMS is critical movement summary of NCHRP bulletin 137 = sum of critical L's
5. Proportioning cycle time according to largest L (ΣCMS) for each phase adjusting for minimum greens necessary for pedestrians, etc.
6. $C = \frac{G}{C_y} C_s$

APPROACH

		(A)	(B)	(C)	(D)	(E)
APPROACH WIDTH	W					
PARKING	P					
LANES	M	2	3	2		
PHASE		P	-	Q		
HOURLY VOLUME	V	990	961	604		
CRITICAL LANE VOLUME (1)	L	1038	877	332		
LANE CAPACITY/ HOUR GREEN (2)	L_s	1450	1450	1450		
APPROACH CAPACITY /HOUR GREEN (3)	C_s	1383	1589	2038		
DESIGN GREEN (4) (SECONDS)	G	76	-	24		
DESIGN GREEN/ CYCLE (5)	G/C_Y	.76	.76	.24		
APPROACH CAPACITY	C	1051	1208	633		
VOLUME CAPACITY	V/C	.94	.80	.95		

Project: Harbor Point

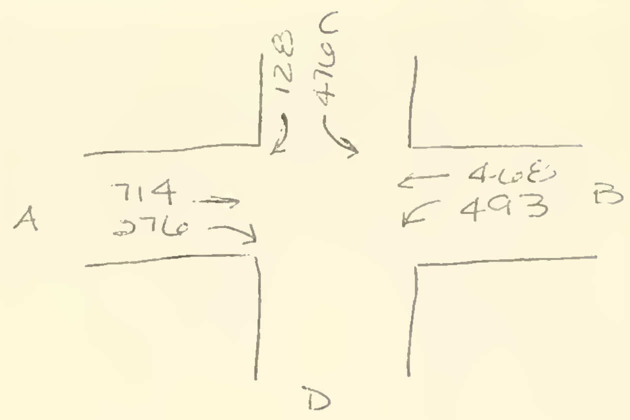
Intersection: Columbia Rd x-way SB ramp

SHEET OF SHEETS DATE 9/82

Comp by: MBC Chkd by:

1990 E-Hour

Critical Movement Analysis



Identify Phasing	1	2	3	4	
	Direction	Net Approach Volume	Lane Use Factor	Lane Volume	Intersection Level of Service
(A)	Columbia Rd	990	.55	545	CMS =
(B)	Columbia Rd	961	.40	384	CMS =
(C)	x-way SB off ramp	604	.55	332	CMS = Vehicles
(D)					
(F)					

Critical Movement Summation CMS

	A	B	C	D	E
Net Through Volume	545	384	332		
Unprotected Left-Turn	—	493	—		
Opposing Left-Turn Volume	493	—	—		
TOTAL	1038	877	332		

INTERSECTION CAPACITY BY LEVEL OF SERVICE

[illegible] /
X-way SB ramp
1990 8-Hour

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION
(see instructions following)

Project No.: [illegible] Analyst: [illegible]

Site: [illegible] Date: Sept. 198[illegible]

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	CE	CW	RS	
2	V_i	Demand volume (vph)	990	961	604	
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	30	30	30	
5	Ef_i	Free-flow emissions (g/veh-m)	.014	.014	.014	
6.1	M_i	Number of lanes in approach i	2	3	2	
6.2	j	Signalized intersections phase identification	P	P	G	
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	1383	1559	2038	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	490	961	604	
6.5	C_y	Signal cycle length (s)	100			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	76	76	24	
6.7	C_i	Capacity of approach i (vph)	1051	1208	1033	
6.8	$P_{i,j}$	Proportion of vehicles that stop	.84 –	.62 –	.98	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	23.1 –	16.6 –	16.4 –	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	16.2	3.9	20.8	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	85	30	81	
9	Rq_i	Average excess running time on approach (s/veh)	65.6	19.06	155.53	
10	Ea_i	emissions from acceleration (g/veh-m)	.10	.10	.10	
11	Ed_i	emissions from deceleration (g/veh-m)	.031	.031	.031	
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)	.030	.022	.021	
13	Lad_i	Length of acceleration and deceleration (m)	80.5	80.5	80.5	
14	Le_i	Length over which excess emissions apply (m)	85	40	81	
15	Fs_i	Average idling emission rate (g/s)	1.491	.317	2.283	
16	Qe	Average emission rate (g/m-s)	.046	.052	.049	
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.043	.050	.047	
18	Qfc_i	Free-flow emission rate (g/s-m)	.004	.004	.002	

17a	.046	.052	.049
b –	.003	.002	.002
	.043	.050	.047

COLUM[illegible]A RO[illegible]/
X-WAY SB [illegible]
1990 8-1[illegible]

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS

(see instructions following)

PROJECT NO.: ____________ ANALYST: ____________

SITE: ____________ DATE: ____________

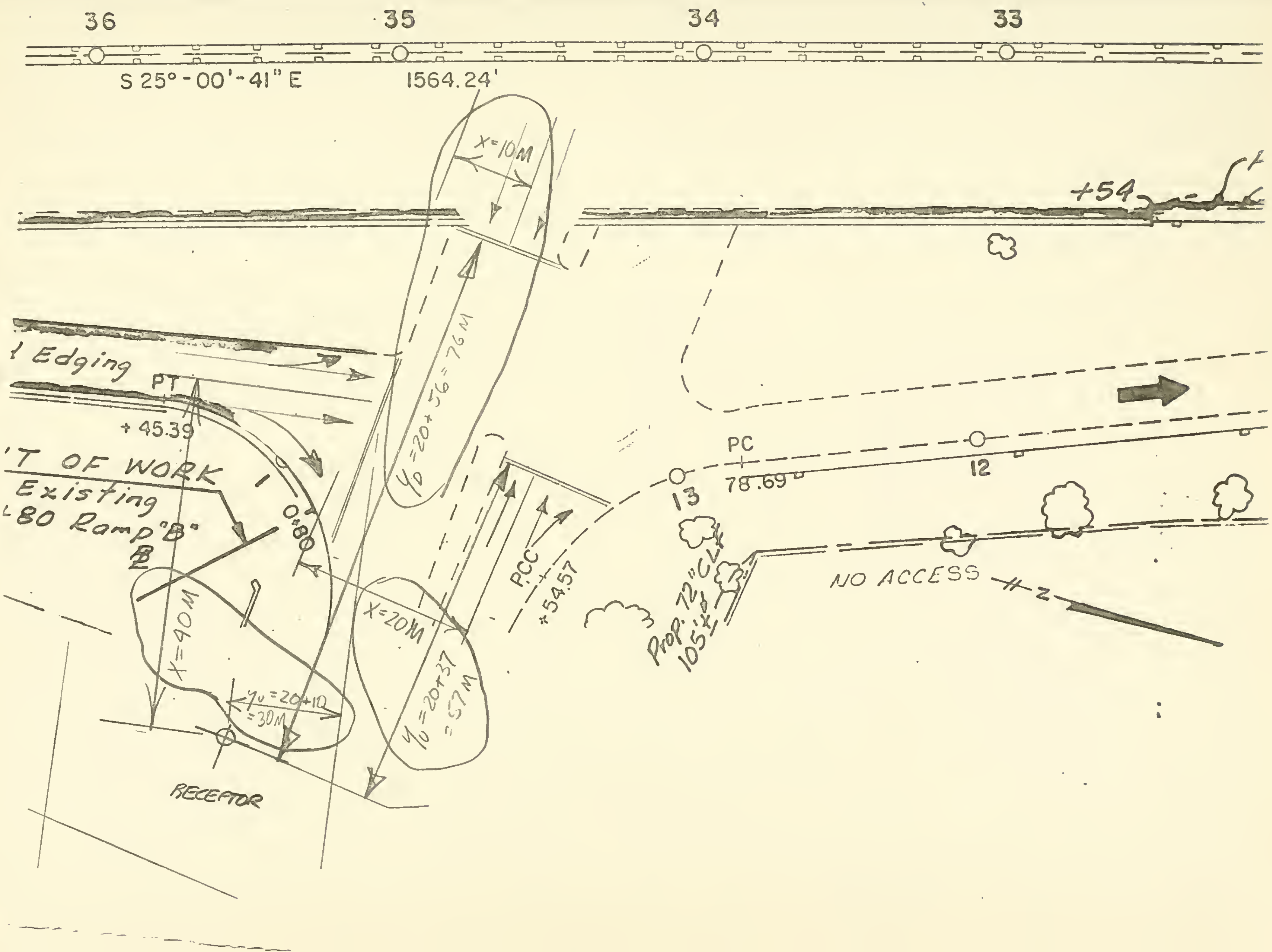
LINE NO.	SYMBOL	INPUT/UNITS	TRAFFIC STREAM			
		BASIC INPUTS	CE	CW	RS	
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED (m s^{-1})	1.6	1.6	1.6	
3	θ	WIND-ROAD ANGLE (deg)	60°	60°	84°	
4	x	LATERAL DISTANCE (m)	35	20	29	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	101	97	93	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	16	67	12	
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	
8	Qe	EXCESS EMISSIONS RATE (g m^{-1} s^{-1})	.043	.050	.047	
9	Qf	FREE FLOW EMISSIONS RATE (g m^{-1} s^{-1})	.004	.004	.002	
9a		STREET CANYON? YES OR NO	N	N	N	
		DISPERSION ANALYSIS				
10	$\chi u Q^{-1}$	NORMALIZED CONCENTRATION (10^{-3} m^{-1}) FREE FLOW	405	590	140	
	Qf	ENTER LINE 9	x .004	x .004	x .002	x
11	χu	NORMALIZED CONCENTRATION (mg m^{-2} s^{-1})	1.62	2.36	0.28	
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷
12	χ	CO CONCENTRATION (mg m^{-3}) THROUGH EMISSIONS	1.01	1.48	0.175	
13	$\chi u Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yu)	50	50	110	
	Qe	ENTER LINE 8	.043	.050	.047	
14	χu	NORMALIZED CONCENTRATION (mg m^{-2} s^{-1})	2.15	2.5	5.17	
	U	ENTER LINE 2	1.6	1.6	1.6	÷
15	χ	CO CONCENTRATION--"MAXIMUM QUEUE"	1.34	1.56	3.23	
16	$\chi u Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yd)	0	0	25	
	Qe	ENTER LINE 8	x .043	x .050	x .047	x
17	χu	NORMALIZED CONCENTRATION (mg m^{-1} s^{-1})	0	0	1.18	
	U	ENTER LINE 2	1.6	1.6	1.6	÷
18	χ	CO CONCENTRATION "IMAGINARY QUEUE"	0	0	1.01	
19	χ	CO (mg m^{-3}) TOTAL	2.35	3.04	2.40	
20	χ	CO CONCENTRATION (ppm)--TOTAL	2.04	2.64	2.09	
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^{+3})				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

3HR = 6.77 + 1.2 = 7.97

1HR = (6.77 ÷ .[illegible]) + [illegible] = 12.07

COLUMBIA ROAD/EXPRESSWAY

NORTHBOUND OFF-RAMP


36
35
34
33
S 25°-00'-41" E
1564.24'
X=10M
+54
Yo=20+56=76M
Edging
PT
+45.39
'T OF WORK
Existing
80 Ramp "B"
0+80
X=20M
PCC
+54.57
PC
78.69
13
12
Prop. 72" CL
105'
NO ACCESS
X=40M
Yu=20+10
=30M
Yo=20+37
=57M
RECEPTOR

1984 EXISTING

INTERSECTION DATA FOR AIR QUALITY ANALYSIS - WORK SHEET

THE MEANING OF THE V/C RESULTS

V/C	IMPLICATIONS
0.70 and below......	No congestion expected
0.80................	Congestion very unlikely
0.90................	Some delays encountered; some congestion during peak events or bad weather
1.00................	Some congestion will be encountered during the peak hour
1.20 and above......	Congestion will extend beyond the peak hour unless traffic travels at other times, involves more transit/shared ride, or trips aren't made (less development; more building vacancies).

NOTES:

1. As described in NCHRP bulletin 187
2. LS = 1450 vph (NCHRP bulletin 187 LOS "E" range)
3. Generally $C_s = L_s \frac{V}{L}$ Cycle length (C_y) = seconds
4. G - cy ($\frac{L}{cms}$) where CMS is critical movement summary of NCHRP bulletin 187 = sum of critical L's
5. Proportioning cycle time according to largest L (÷CMS) for each phase adjusting for minimum greens necessary for pedestrians, etc.
6. $C = \frac{G}{C_y} C_s$

APPROACH

		Ⓐ	Ⓑ	Ⓒ	Ⓓ	Ⓔ
APPROACH WIDTH	W					
PARKING	P					
LANES	M	2	2		2	
PHASE			R		Q	
HOURLY VOLUME	V	726	896		160	
CRITICAL LANE VOLUME (1)	L	583	677		166	
LANE CAPACITY/ HOUR GREEN (2)	L_s	1450	1450		1450	
APPROACH CAPACITY /HOUR GREEN (3)	C_s	1806	1919		1398	
DESIGN GREEN (4) (SECONDS)	G	80	80		20	
DESIGN GREEN/ CYCLE (5)	G/C_Y	.80	.80		.20	
APPROACH CAPACITY	C	1445	1535		280	
VOLUME CAPACITY	V/C	0.50	0.58		0.57	

Project: Columbia Point

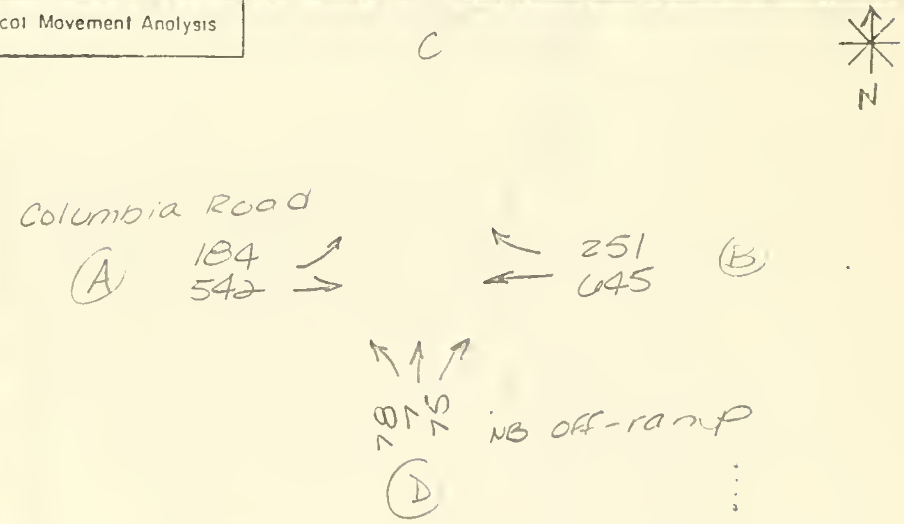
Intersection: Columbia Rd. X-way NB off-Ramp

SHEET OF SHEETS DATE:

Comp by: MBC Chkd by:

1984 EXISTING B HOUR

Critical Movement Analysis



Identify / Phasing	1	2	3	4

Direction		Net Approach Volume	Lane Use Factor	Lane Volume
CE	Ⓐ	726	.55	399
CW	Ⓑ	896	.55	493
	Ⓒ			
RN	Ⓓ	160	.55	88
	Ⓔ			

	A	B	C	D	E
Net Through Volume	399	493		88	
Unprotected Left-Turn	184	—		78	
Opposing Left-Turn Volume	—	184		—	
TOTAL	583	677		166	

Intersection Level of Service

Critical Movement Summation CMS

CMS =

CMS =

CMS = Vehicles

Approach Lanes	Lane-Use Factor
1	1.00
2	[illegible]
3	[illegible]
4	[illegible]

INTERSECTION CAPACITY BY LEVEL OF SERVICE

Level of Service	Limits of Capacity (VPH) [illegible]	[illegible]
A	0	900
B	901	[illegible]
C	[illegible]	[illegible]
D	[illegible]	[illegible]
E	[illegible]	[illegible]
F	([illegible])	[illegible]

ramp S.E. X-way
1984 EXISTING
8 HOUR

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION
(see instructions following)

Project No.: 463 Analyst: M. Chassé

Site: Columbia Point Date: 3/6/85

Step	Symbol	Input/Units	Traffic Stream					
1	i	Road segment (or approach identification)	CW	CE	RN			
2	V_i	Demand volume (vph)	896	726	160			
3	C_i	Free-flow capacity (vph)	—	—	—			
4	S_i	Cruise speed (mph)	30	30	25			
5	Ef_i	Free-flow emissions (g/veh-m)	.024	.024	.029			
6.1	H_i	Number of lanes in approach i	2	2	2			
6.2	j	Signalized intersections phase identification	P	P	Q			
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	1919	1806	1398			
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	896	726	160			
6.5	C_y	Signal cycle length (s)	100					
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	80	80	20			
6.7	C_i	Capacity of approach i (vph)	1535	1445	280			
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.38	0.33	0.90			
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	9.5	6.7	3.2			
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	1.4	1.0	1.3			
8	Lq_i	Length of vehicle queue for approach i ~~(veh-m/lane)~~ (m/L)	21.8	15.4	9.0			
9	Rq_i	Average excess running time on approach (s/veh)	7.1	5.8	52.7			
10	Ea_i	emissions from acceleration (g/veh-m)	.10	.10	.11			
11	Ed_i	emissions from deceleration (g/veh-m)	.031	.031	.045			
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)	.012	.009	.005			
13	Lad_i	Length of acceleration and deceleration (m)	80.5	80.5	55.9			
14	Le_i	Length over which excess emissions apply (m)	40	40	40			
15	Fs_i	Average idling emission rate (g/s)	.033	.005	1.259			
16	Qe	Average emission rate (g/m-s)	.025	.018	.013			
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.023	.016	.012			
18	Qfc_i	Free-flow emission rate (g/s-m)	.006	.005	.001			

17a .025 .018 .013
17b .002 .002 .001
.023 .016 .012

Columbia ECC 4 / NB
off ramp S.E X-way
1984 EXISTING
8 HOUR

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

PROJECT NO.: 463 ANALYST: M. Chasse
SITE: Columbia Point DATE: 3/6/85

LINE NO.	SYMBOL	INPUT/UNITS	TRAFFIC STREAM			
		BASIC INPUTS	CW	CE	RN	
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED ($m\ s^{-1}$)	1.6	1.6	1.6	
3	θ	WIND-ROAD ANGLE (deg)	6°	6°	84°	
4	x	LATERAL DISTANCE (m)	10	20	40	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	98	57	30	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	76	42	21	
7	σ_{z_0}	INITIAL DISPERSION (m)	5.0	5.0	5.0	
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.023	.016	.012	
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.006	.005	.001	
9a		STREET CANYON? YES OR NO	NO	NO	NO	
		DISPERSION ANALYSIS				
10	χUQ^{-1}	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	800	590	120	
	Qf	ENTER LINE 9	× .006	× .005	× .001	×
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	4.8	3.0	0.1	
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	3.0	1.9	0.1	
13	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	290	0	70	
	Qe	ENTER LINE 8	× .023	× .016	× .012	
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	6.7	0	0.8	
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷
15	χ	CO CONCENTRATION--"MAXIMUM QUEUE"	4.2	0	0.5	
16	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	190	0	40	
	Qe	ENTER LINE 8	× .023	× .016	× .012	×
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	4.4	0	0.5	
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷
18	χ	CO CONCENTRATION--"IMAGINARY QUEUE"	-2.8	0	0.3	
19	χ	CO ($mg\ m^{-3}$) TOTAL	4.4	1.9	0.4	
20	χ	CO CONCENTRATION (ppm)--TOTAL	3.8	1.7	0.3	
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^{+3})				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

8 HOUR TOTAL CO = 5.8 + 1.5 = 7.3 ppm
1 HOUR TOTAL CO = 5.8(÷.7) = 8.3 + 3.0 = 11.3 ppm

1990

INTERSECTION DATA FOR AIR QUALITY ANALYSIS - WORK SHEET

THE MEANING OF THE V/C RESULTS

V/C	IMPLICATIONS
0.70 and below......	No congestion expected
0.80................	Congestion very unlikely
0.90................	Some delays encountered; some congestion during peak events or bad weather
1.00................	Some congestion will be encountered during the peak hour
1.20 and above......	Congestion will extend beyond the peak hour unless traffic travels at other times, involves more transit/shared ride, or trips aren't made (less development; more building vacancies).

NOTES

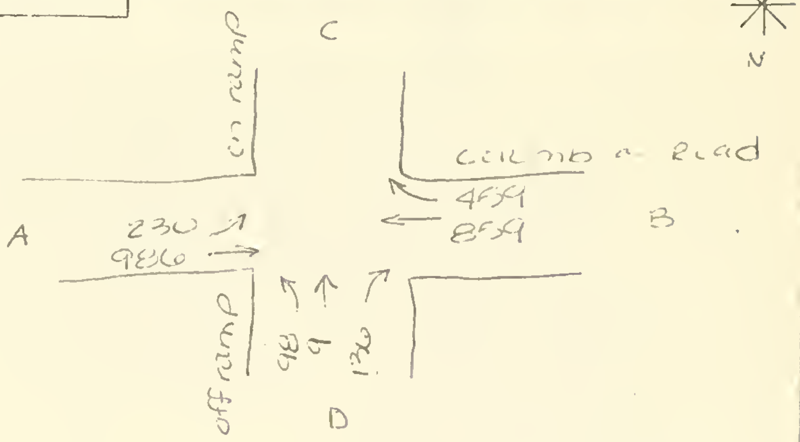
1. As described in NCHRP bulletin 187
2. 13 - 1450 vph (NCHRP bulletin 187 LOS "E" range)
3. Generally $C_s = L_s \frac{V}{L}$ ... cycle length (C_y) = seconds
4. $G = Cy\ (\frac{L}{CMS})$ where CMS is critical movement summary of NCHRP bulletin 187 = sum of critical L's
5. Proportioning cycle time according to largest L (÷CMS) for each phase adjusting for minimum greens necessary for pedestrians, etc.
6. $C = \frac{G}{C_y} C_s$

APPROACH

		(A)	(B)	(C)	(D)	(E)
APPROACH WIDTH	W					
PARKING	P					
LANES	M	2	2	—	2	
PHASE			P	—	Q	
HOURLY VOLUME	V	1216	1318	—	243	
CRITICAL LANE VOLUME (1)	L	899	955	—	232	
LANE CAPACITY/ HOUR GREEN (2)	L_s	1450	1450	—	1450	
APPROACH CAPACITY /HOUR GREEN (3)	C_s	1961	2001	—	1519	
DESIGN GREEN (4) (SECONDS)	G	—	81	—	19	
DESIGN GREEN/ CYCLE (5)	G/C_y	.81	.81	—	.19	
APPROACH CAPACITY	C	1588	1620	—	289	
VOLUME CAPACITY	V/C	.77	.81	—	.84	

Project: Columbia Point	SHEET OF SHEETS DATE: 4/(?)
Intersection: Columbia Road X-Way NB ramp	Comp by: DMS Chkd by:
	990 E-Hour

Critical Movement Analysis



Identify Phasing	1	2	3	4	Intersection Level of Service
Direction	Net Approach Volume	Lane Use Factor	Lane Volume		Critical Movement Summation CMS
Columbia Rd (A)	1216	.55	669		CMS =
Columbia Rd (B)	1318	.55	725		CMS =
— (C)	—	—	—		CMS = Vehicles
X-Way NB off ramp (D)	243	.55	134		
(E)					

	A	B	C	D	E
Net Through Volume	669	725	—	134	
Unprotected Left-Turn	230	—	—	98	
Opposing Left-Turn Volume	—	230	—	—	
TOTAL	899	955	—	232	

INTERSECTION CAPACITY BY LEVEL OF SERVICE

LEVEL OF SERVICE	CAPACITY (VPH)	
A	0	900
B	901	1050
C	1051	1200
D	1201	1350
E	1351	1500
F	(Forced flow)	

Columbia Road /
X-way NB ramp
1990 8 HOUR

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION
(see instructions following)

Project No.: 463 Analyst: M Cmasse

Site: Harbor Point Date: Sept. 1985

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	Cl	C	RN	
2	V_i	Demand volume (vph)	1216	1318	243	
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	30	30	25	
5	Ef_i	Free-flow emissions (g/veh-m)	.014	.014	.017	
6.1	M_i	Number of lanes in approach i	2	2	2	
6.2	j	Signalized intersections phase identification	?	?	Q	
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	1961	2001	1519	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	1216	1318	243	
6.5	C_y	Signal cycle length (s)	100			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	81	81	19	
6.7	C_i	Capacity of approach i (vph)	1588	1620	289	
6.8	$P_{i,j}$	Proportion of vehicles that stop	.51	.56	.23	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	17.2	20.5	1.5	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	3.3	4.4	5.3	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	45	54	15	
9	Rq_i	Average excess running time on approach (s/veh)	12.28	15.1	75.3	
10	Ea_i	emissions from acceleration (g/veh-m)	.10	.10	.11	
11	Ed_i	emissions from deceleration (g/veh-m)	.031	.031	.038	
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)	.022	.027	.002	
13	Lad_i	Length of acceleration and deceleration (m)	80.5	80.5	55.9	
14	Le_i	Length over which excess emissions apply (m)	45	54	40	
15	Fs_i	Average idling emission rate (g/s)	.193	.303	.426	
16	Qe	Average emission rate (g/m-s)	.044	.046	.013	
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.041	.043	.012	
18	Qfc_i	Free-flow emission rate (g/s-m)	.005	.005	.001	

17a	.044	.046	.013
17b	-.002	.003	.001
	.041	.043	.012

COLU[illegible]
X-WAY NB [illegible]
1990 8-hour

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

PROJECT NO.: ______________________ ANALYST: ______________________

SITE: ______________________ DATE: ______________________

LINE NO.	SYMBOL	INPUT/UNITS	TRAFFIC STREAM			
		BASIC INPUTS	CE	CW	KN	
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED ($m\ s^{-1}$)	1.6	1.6	1.6	
3	θ	WIND-ROAD ANGLE (deg)	60°	60°	84°	
4	x	LATERAL DISTANCE (m)	10	20	40	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	121	60	25	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	76	6	10	
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.041	.043	.012	
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.005	.005	.001	
9a		STREET CANYON? YES OR NO	N	N	N	
		DISPERSION ANALYSIS				
10	χUQ^{-1}	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	800	590	120	
	Qf	ENTER LINE 9	x .005	x .005	x .001	x
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	4	2.95	.36	
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	2.5	1.84	.225	
13	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	350	0	50	
	Qe	ENTER LINE 8	.041	.043	.012	
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	14.35	0	0.6	
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷
15	χ	CO CONCENTRATION - "MAXIMUM QUEUE"	8.97	0	0.375	
16	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	190	0	20	
	Qe	ENTER LINE 8	x .041	x .043	x .012	x
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	7.79	0	.24	
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷
18	χ	CO CONCENTRATION "IMAGINARY QUEUE"	4.87	0	0.15	
19		CO ($mg\ m^{-3}$) TOTAL	6.60	1.84	.45	
20	χ	CO CONCENTRATION (ppm) TOTAL	5.74	1.6	.39	
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^{+3})				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

8 Hr = 7.73 + 1.2 = 8.93

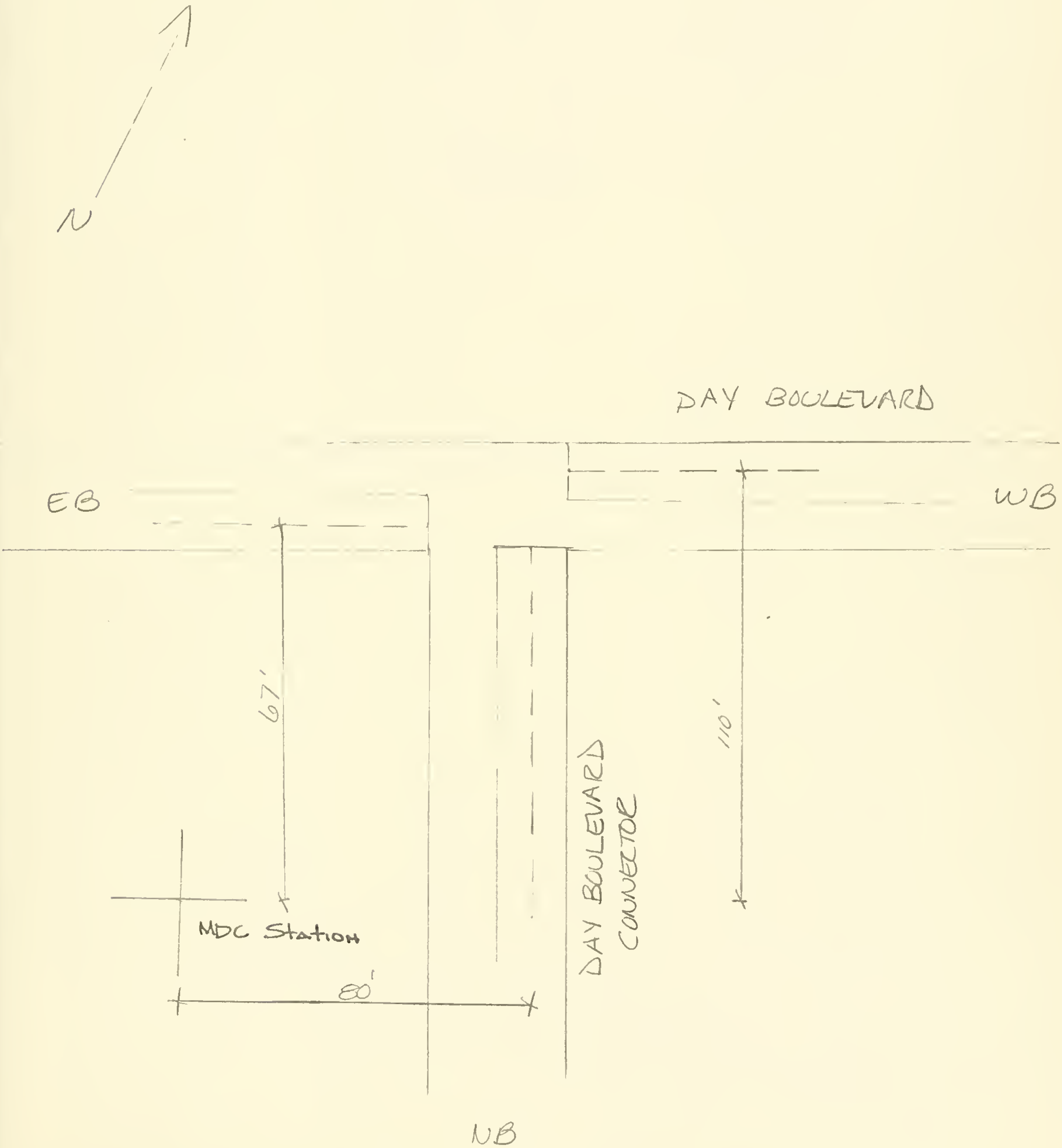
1 Hr = (7.73 ÷ .7) + 2.4 = 13.44

DAY BLVD./DAY BLVD. CONNECTOR

H.W. MOORE ASSOCIATES, INC.
CONSULTING ENGINEERS
BOSTON, MASS. 02118 357-8145

SUBJECT Columbia Point
Air Quality Analysis

SHEET ____ OF ____
DATE ____
COMP. BY MBC
CHECK BY JRN



1984 EXISTING

INTERSECTION DATA FOR AIR QUALITY ANALYSIS - WORK SHEET

THE MEANING OF THE V/C RESULTS

V/C	IMPLICATIONS
0.70 and below......	No congestion expected
0.80................	Congestion very unlikely
0.90................	Some delays encountered; some congestion during peak events or bad weather
1.00................	Some congestion will be encountered during the peak hour
1.20 and above......	Congestion will extend beyond the peak hour unless traffic travels at other times, involves more transit/shared ride, or trips aren't made (less development; more building vacancies).

NOTES:

1. As described in NCHRP bulletin 187
2. LS = 1450 vph (NCHRP bulletin 187 LOS "E" range)
3. Generally $C_s = L_s \frac{V}{L}$ Cycle length (C_y) = seconds
4. $G = cy\ (\frac{L}{cms})$ where CMS is critical movement summary of NCHRP bulletin 187 = sum of critical L's
5. Proportioning cycle time according to largest L (÷CMS) for each phase adjusting for minimum greens necessary for pedestrians, etc.
6. $C = \frac{G}{C_y} C_s$

APPROACH

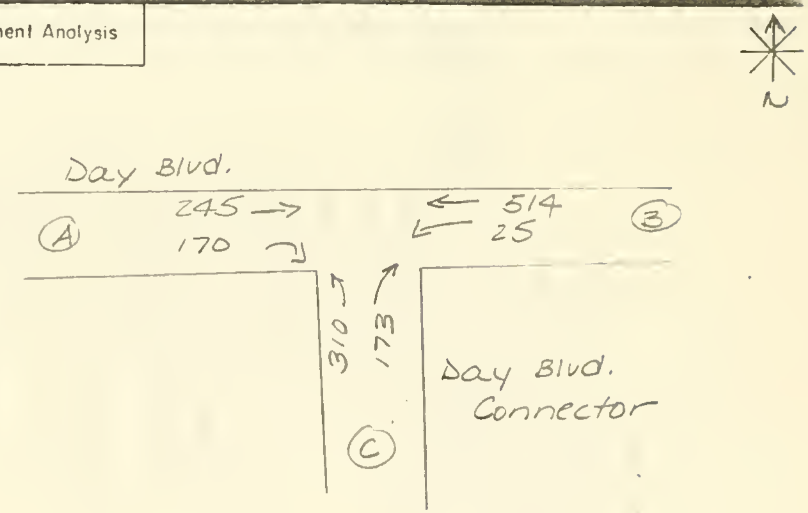
		A	B	C	D	E
APPROACH WIDTH	W					
PARKING	P					
LANES	M	1	2	1		
PHASE		P	Q	R		
HOURLY VOLUME	V	245	539	310		
CRITICAL LANE VOLUME (1)	L	245	296	310		
LANE CAPACITY/ HOUR GREEN (2)	L_s	1450	1450	1450		
APPROACH CAPACITY /HOUR GREEN (3)	C_s	1450	2640	1450		
DESIGN GREEN (4) (SECONDS)	G	28	26	26		
DESIGN GREEN/ CYCLE (5)	G/C_Y	.35	.33	.32		
APPROACH CAPACITY	C	508	871	464		
VOLUME CAPACITY	V/C	.48	.62	.67		

Project: Calumet Point
Intersection: Day Blvd / Day Blvd. Connector

SHEET OF SHEETS DATE:
Comp by: MBC Chkd by:

EXISTING 8 HR.

Critical Movement Analysis



Identify / Phasing	1	2	3	4

Direction	Net Approach Volume	Lane Use Factor	Lane Volume
Day Blvd. EB (A)	245	1	245
Day Blvd. WB (B)	539	.55	296
Conn. NB (C)	310	1	310
(D)			
(E)			

	A	B	C	D	E
Net Through Volume	245	296	310		
Unprotected Left-Turn					
Opposing Left-Turn Volume					
TOTAL	245	296	310		

Intersection Level of Service

Critical Movement Summation CMS

CMS =

CMS =

CMS = Vehicles

INTERSECTION CAPACITY BY LEVEL OF SERVICE

Day Blvd. / Day Blvd. Connector
1984 EXISTING
8 HOUR

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION
(see instructions following)

Project No.: 463 Analyst: MBC

Site: Columbia Point Date: 3/5/85

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	NB	EB	WB	
2	V_i	Demand volume (vph)	310	245	539	
3	C_i	Free-flow capacity (vph)	—	—	—	
4	S_i	Cruise speed (mph)	25	15	25	
5	Ef_i	Free-flow emissions (g/veh-m)	.029	.048	.029	
6.1	N_i	Number of lanes in approach i	1	1	2	
6.2	j	Signalized intersections phase identification	1	2	3	
6.3	$Cs_{i,j}$	Canacity service volume of approach i for phase j (vph of green)	1450	1450	2640	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	310	245	539	
6.5	C_y	Signal cycle length (s)	80			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	26	28	26	
6.7	C_i	Capacity of approach i (vph)	464	508	871	
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.86	0.78	.85	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	5.92	4.25	10.18	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	2.0	0.9	1.6	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	32	21	24	
9	Rq_i	Average excess running time on approach (s/veh)	38.5	26.7	29.6	
10	Ea_i	emissions from acceleration (g/veh-m)	.11	.165	.11	
11	Ed_i	emissions from deceleration (g/veh-m)	.037	.061	.037	
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)	.0109	.0120	.0187	
13	Lad_i	Length of acceleration and deceleration (m)	55.9	20.1	55.9	
14	Le_i	Length over which excess emissions apply (m)	40	40	40	
15	Fs_i	Average idling emission rate (g/s)	0.352	0.197	0.449	
16	Qe	Average emission rate (g/m-s)	.024	.011	.037	
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.022	.008	.033	
18	Qfc_i	Free-flow emission rate (g/s-m)	.002	.003	.004	

17a	.024	.011	.037
−17b	.002	.003	.004
	.022	.008	.033

Day Blvd./Day Blvd. Connector
1984 EXISTING
8 HOUR

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

PROJECT NO.: 463 ANALYST: M. Chasse
SITE: Columbia Point DATE: 3/5/85

LINE NO.	SYMBOL	INPUT/UNITS	TRAFFIC STREAM			
		BASIC INPUTS	NB	EB	WB	
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED (m s-1)	1.6	1.6	1.6	
3	θ	WIND-ROAD ANGLE (deg)	84°	6°	6°	
4	x	LATERAL DISTANCE (m)	24	20	34	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	69	52	120	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	37	31	96	
7	σ_{z_0}	INITIAL DISPERSION (m)	5.0	5.0	5.0	
8	Qe	EXCESS EMISSIONS RATE (g m-1 s-1)	.022	.008	.033	
9	Qf	FREE FLOW EMISSIONS RATE (g m-1 s-1)	.002	.003	.004	
9a		STREET CANYON? YES OR NO	NO	NO	NO	
		DISPERSION ANALYSIS				
10	χUQ^{-1}	NORMALIZED CONCENTRATION (10^{-3} m-1) FREE FLOW	135	590	410	
	Qf	ENTER LINE 9	x .002	x .003	x .004	x
11	χU	NORMALIZED CONCENTRATION (mg m-2 s-1)	0.3	1.8	1.6	
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷
12	χ	CO CONCENTRATION (mg m-3) THROUGH EMISSIONS	0.2	1.1	1.0	
13	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	110	0	15	
	Qe	ENTER LINE 8	x .022	x .008	x .033	
14	χU	NORMALIZED CONCENTRATION (mg m-2 s-1)	2.4	0	0.5	
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷
15	χ	CO CONCENTRATION--"MAXIMUM QUEUE"	1.5	0	0.3	
16	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	110	0	5	
	Qe	ENTER LINE 8	x .022	x .008	x .033	x
17	χU	NORMALIZED CONCENTRATION (mg m-1 s-1)	2.4	0	0.2	
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷
18	χ	CO CONCENTRATION--"IMAGINARY QUEUE"	- 1.5	0	-0.1	
19	χ	CO (mg m-3) TOTAL	0.2	1.1	1.2	
20	χ	CO CONCENTRATION (ppm)--TOTAL	0.2	1.0	1.0	
		OPTIONAL z-CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m+3)				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

8 HOUR TOTAL = 2.2 + 1.5 = 3.7 ppm
1 HOUR TOTAL = 2.2 (÷ .7) = 3.1 + 3.0 = 6.1 ppm

1990 ALTERNATIVE A

INTERSECTION DATA FOR AIR QUALITY ANALYSIS - WORK SHEET

THE MEANING OF THE V/C RESULTS

V/C	IMPLICATIONS
0.70 and below	No congestion expected
0.80	Congestion very unlikely
0.90	Some delays encountered; some congestion during peak events or bad weather
1.00	Some congestion will be encountered during the peak hour
1.20 and above	Congestion will extend beyond the peak hour unless traffic travels at other times, involves more transit/shared ride, or trips aren't made (less development; more building vacancies).

NOTES

1. As described in NCHRP bulletin 187
2. LS = 1450 vph (NCHRP bulletin 187 LOS "E" range)
3. Generally $C_s = L_s \frac{?}{L}$ cycle length (C_y) = seconds
4. $G = cy\ (\frac{L}{cms})$ where CMS is critical movement summary of NCHRP bulletin 187 = sum of critical L's
5. Proportioning cycle time according to largest L (÷CMS) for each phase adjusting for minimum greens necessary for pedestrians, etc.
6. $C = \frac{G}{C_y} C_s$

APPROACH

		(A)	(B)	(C)	(D)	(E)
APPROACH WIDTH	W					
PARKING	P					
LANES	M	1	2	–	2	
PHASE		–	R	–	S	
HOURLY VOLUME	V	366	680	–	426	
CRITICAL LANE VOLUME (1)	L	340	408	–	532	
LANE CAPACITY/ HOUR GREEN (2)	L_s	1450	1450	–	1450	
APPROACH CAPACITY /HOUR GREEN (3)	C_s	1305	2417	–	1161	
DESIGN GREEN (4) (SECONDS)	G	43	43	–	57	
DESIGN GREEN/ CYCLE (5)	G/C_Y	.43	.43	–	.57	
APPROACH CAPACITY	C	581	1039	—	662	
VOLUME CAPACITY	V/C	.63	.65	–	.64	

Project: Harn - Rt

Intersection: Day Blvd. Day Blvd Connector

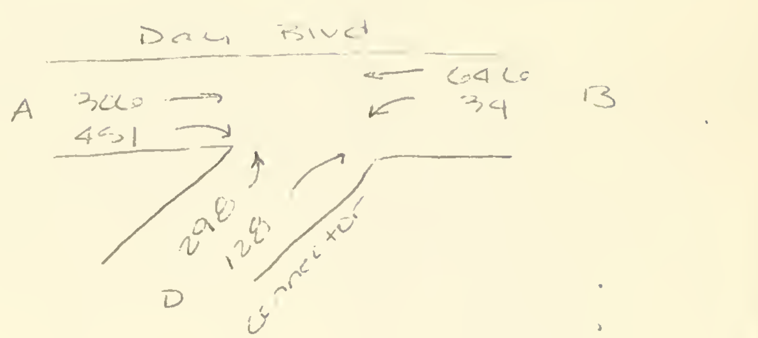
SHEET OF SHEETS DATE:

Comp by: MBx Chkd by:

1990 E ...

Alt. A

Critical Movement Analysis



Identify Phasing	1	2	3	4	Intersection Level of Service

Direction	Net Approach Volume	Lane Use Factor	Lane Volume
Day Blvd (A)	366	1.0	366
Day Blvd (B)	680	.55	374
— (C)	—	—	—
Day Connector (D)	426	.55	234
(E)			

	A	B	C	D	E
Net Through Volume	366	374	–	234	
Unprotected Left Turn	–	34	–	298	
Opposing Left-Turn Volume	34	–	–	–	
TOTAL	340	468	–	532	

Critical Movement Summation CMS

CMS =

CMS =

CMS = Vehicles

APPROACH LANES	LANE USE FACTOR
1	1.00
2	0.55
3	0.40
4	0.30

INTERSECTION CAPACITY BY LEVEL OF SERVICE

LEVEL OF SERVICE	LIMITS OF CAPACITY (VPH) LOW	HIGH
A	0	900
B	901	1050
C	1051	1200
D	1201	1350
E	1351	1500
F	(Demand over)	1500

[illegible] Blvd. / [illegible]
Blvd. Connector
1990 8-HOUR
AM # A

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION
(see instructions following)

Project No.: 403 Analyst: M. Chasse

Site: Harbor Point Date: Sept. 1986

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	EB	WB	NB	
2	V_i	Demand volume (vph)	366	680	426	
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	15	25	25	
5	Ef_i	Free-flow emissions (g/veh-m)	0.028	.017	.017	
6.1	M_i	Number of lanes in approach i	1	2	2	
6.2	j	Signalized intersections phase identification	R	R	S	
6.3	$Cs_{i,j}$	Canacity service volume of approach i for phase j (vph of green)	1305	2417	1161	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	366	680	426	
6.5	C_y	Signal cycle length (s)	160			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	43	43	57	
6.7	C_i	Capacity of approach i (vph)	581	1039	662	
6.8	$P_{i,j}$	Proportion of vehicles that stop	.74	.79	.68	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	6.3	14.9	8.0	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	1.1	1.9	1.8	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	32	37	21	
9	Rq_i	Average excess running time on approach (s/veh)	27.9	29.1	24.4	
10	Ea_i	emissions from acceleration (g/veh-m)	.164	.110	.110	
11	Ed_i	emissions from deceleration (g/veh-m)	.061	.038	.038	
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)	.014	.022	.012	
13	Lad_i	Length of acceleration and deceleration (m)	20.1	55.9	55.9	
14	Le_i	Length over which excess emissions apply (m)	40	40	40	
15	Fs_i	Average idling emission rate (g/s)	.193	.414	.209	
16	Qe	Average emission rate (g/m-s)	.012	.041	.022	
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.010	.038	.021	
18	Qfc_i	Free-flow emission rate (g/s-m)	.002	.003	.002	

17a .012 .041 .022
− 17b .002 .003 .001
.010 .038 .021

DU17 [illegible]
1990 [illegible]
RLT [illegible]

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS

(see instructions following)

PROJECT NO.: ______ ANALYST: ______

SITE: ______ DATE: ______

LINE NO.	SYMBOL	INPUT/UNITS	TRAFFIC STREAM			
		BASIC INPUTS	EB	WB	NB	
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED ($m\ s^{-1}$)	1.6	1.6	1.6	
3	θ	WIND-ROAD ANGLE (deg)	6°	6°	84°	
4	x	LATERAL DISTANCE (m)	20	34	24	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	50	133	31	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	18	96	0	
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.010	.038	.021	
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.002	.003	.002	
9a		STREET CANYON? YES OR NO	NO	NO	NO	
		DISPERSION ANALYSIS				
10	χUQ^{-1}	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	580	420	140	
	Qf	ENTER LINE 9	x .002	x .003	x .002	x
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	1.16	1.26	0.28	
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	0.725	0.79	0.175	
13	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	75	50	75	
	Qe	ENTER LINE 8	.010	.038	.021	
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	.75	1.9	0	
	U	ENTER LINE 2	÷ 1.6	1.6	1.6	÷
15	χ	CO CONCENTRATION "MAXIMUM QUEUE"	0.47	1.19	1.575	
16	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	0	10	0	
	Qe	ENTER LINE 8	x .010	x .038	x .021	x
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	0	0.38	0	
	U	ENTER LINE 2	1.6	1.6	1.6	
18	χ	CO CONCENTRATION "IMAGINARY QUEUE"	0	0.24	0	
19		CO ($mg\ m^{-3}$) TOTAL	1.195	2.55	1.75	
20	χ	CO CONCENTRATION (ppm) TOTAL	1.04	2.22	1.52	
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^{+3})				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

8 HR = 4.78 + 1.2 = 5.98

1 HR = (4.78 ÷ .7) + 2.4 = 9.2[illegible]

1990 ALTERNATIVE B

INTERSECTION DATA FOR AIR QUALITY ANALYSIS - WORK SHEET

THE MEANING OF THE V/C RESULTS

V/C	IMPLICATIONS
0.70 and below......	No congestion expected
0.80................	Congestion very unlikely
0.90................	Some delays encountered; some congestion during peak events or bad weather
1.00................	Some congestion will be encountered during the peak hour
1.20 and above......	Congestion will extend beyond the peak hour unless traffic travels at other times, involves more transit/shared ride, or trips aren't made (less development; more building vacancies).

NOTES

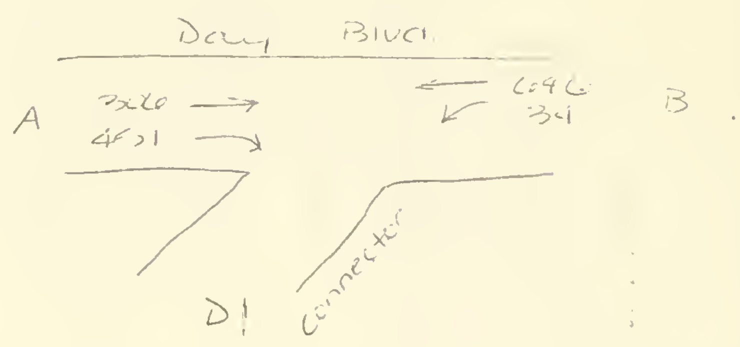
1. As described in NCHRP bulletin 197
2. LS - 1450 vph (NCHRP bulletin 197 LOS "E" range)
3. Generally $C_s = L_s \frac{V}{L}$ ... cycle length (C_y) = seconds
4. $G = cy\,(\frac{L}{CMS})$ where CMS is critical movement summary of NCHRP bulletin 197 = sum of critical L's
5. Proportioning cycle time according to largest L (÷CMS) for each phase adjusting for minimum greens necessary for pedestrians, etc.
6. $C = \frac{G}{C_y} C_s$

APPROACH

		A	B	C	D	E
APPROACH WIDTH	W					
PARKING	P					
LANES	M	2	2	—	—	
PHASE		P	Q	—	—	
HOURLY VOLUME	V	757	680	—	—	
CRITICAL LANE VOLUME (1)	L	450	408	—	—	
LANE CAPACITY/HOUR GREEN (2)	L_s	1450	1450			
APPROACH CAPACITY /HOUR GREEN (3)	C_s	2439	2417			
DESIGN GREEN (4) (SECONDS)	G	62	48			
DESIGN GREEN/CYCLE (5)	G/C_Y	.52	.48			
APPROACH CAPACITY	C	1268	1160			
VOLUME CAPACITY	V/C	.60	.57			

Project: Harbor Point	SHEET OF SHEETS DATE:
Intersection: Davy Blvd	Comp by: MBC Chkd by:
Davy Connector	1990 PM Hour
	Alt B

Critical Movement Analysis



Identify Phasing	1	2	3	4	Intersection Level of Service

Direction		Net Approach Volume	Lane Use Factor	Lane Volume
Davy Blvd	A	757	.55	416
Davy Blvd.	B	680	.55	374
—	C	—	—	—
—	D	—	—	—
	E			

	A	B	C	D	E
Net Through Volume	416	374	—	—	
Unprotected Left-Turn	-	34	—	—	
Opposing Left-Turn Volume	34	-	—	—	
TOTAL	450	408	—	—	

Critical Movement Summation CMS

CMS =

CMS =

CMS = Vehicles

APPROACH LANES	LANE USE FACTOR
1	1.00
2	0.55
3	0.40
4	0.30

INTERSECTION CAPACITY BY LEVEL OF SERVICE

LEVEL OF SERVICE	LIMIT OF CAPACITY (VPH) LOW	HIGH
A	0	900
B	901	1,050
C	1,051	1,200
D	1,201	1,350
E	1,351	1,500
F	(Forced flow)	1,500

Daly Blvd. / Daly Blvd.
Connector
1990 8-HOUR
Alt. # 13

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION
(see instructions following)

Project No.: 4603 Analyst: M. Chasse

Site: Harbor Point Date: Sept. 1985

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	EB	WB		
2	V_i	Demand volume (vph)	757	680		
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	15	25		
5	Ef_i	Free-flow emissions (g/veh-m)	.028	.017		
6.1	N_i	Number of lanes in approach i	2	2		
6.2	j	Signalized intersections phase identification	P	Q		
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	2439	2417		
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	757	680		
6.5	C_y	Signal cycle length (s)	100			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	52	48		
6.7	C_i	Capacity of approach i (vph)	1268	1160		
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.70	0.72		
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	14.7	13.6		
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	1.5	1.4		
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	35	33		
9	Rq_i	Average excess running time on approach (s/veh)	21	23		
10	Ea_i	emissions from acceleration (g/veh-m)	.104	.110		
11	Ed_i	emissions from deceleration (g/veh-m)	.061	.058		
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)	.033	.020		
13	Lad_i	Length of acceleration and deceleration (m)	20.1	65.9		
14	Le_i	Length over which excess emissions apply (m)	52	48		
15	Fs_i	Average idling emission rate (g/s)	.344	.309		
16	Qe	Average emission rate (g/m-s)	.019	.030		
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.015	.028		
18	Qfc_i	Free-flow emission rate (g/s-m)	.006	.003		

17a .019 .030
− 17b .004 .002
.015 .028

1990 8 Hour
Alt. C

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS

(see instructions following)

PROJECT NO.: ______ ANALYST: ______

SITE: ______ DATE: ______

LINE NO.	SYMBOL	INPUT/UNITS	TRAFFIC STREAM			
		BASIC INPUTS	EB	WB		
1	SC	STABILITY CLASS	D	D		
2	U	WIND SPEED ($m\ s^{-1}$)	1.6	1.6		
3	θ	WIND-ROAD ANGLE (deg)	6°	6°		
4	x	LATERAL DISTANCE (m)	20	34		
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	53	144		
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	18	96		
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5		
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.015	.028		
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.006	.003		
9a		STREET CANYON? YES OR NO	NO	NO		
		DISPERSION ANALYSIS				
10	χUQ^{-1}	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	580	420		
	Qf	ENTER LINE 9	x .006	x .003	x	x
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	3.48	1.26		
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷	÷
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	2.18	0.79		
13	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	75	75		
	Qe	ENTER LINE 8	.015	.028		
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	1.125	2.1		
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷	÷
15	χ	CO CONCENTRATION - "MAXIMUM QUEUE"	0.70	1.31		
16	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	0	10		
	Qe	ENTER LINE 8	x .015	x .028	x	x
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	0	.28		
	U	ENTER LINE 2	1.6	1.6		
18	χ	CO CONCENTRATION - "IMAGINARY QUEUE"	0	0.175		
19	χ	CO ($mg\ m^{-3}$) TOTAL	2.88	1.925		
20	χ	CO CONCENTRATION (ppm) - TOTAL	2.5	1.67		
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^{+3})				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

8Hr: 4.17 + 1.2 = 5.37

1Hr: (4.17 ÷ .7) + 2.4 = 8.36

1990 No-Improvements

INTERSECTION DATA FOR AIR QUALITY ANALYSIS - WORK SHEET

THE MEANING OF THE V/C RESULTS

V/C	IMPLICATIONS
0.70 and below......	No congestion expected
0.80................	Congestion very unlikely
0.90................	Some delays encountered; some congestion during peak events or bad weather
1.00................	Some congestion will be encountered during the peak hour
1.20 and above......	Congestion will extend beyond the peak hour unless traffic travels at other times, involves more transit/shared ride, or trips aren't made (less development; more building vacancies).

NOTES

1. As described in NCHRP bulletin 187
2. 15 - 1450 vph (NCHRP bulletin 187 LOS "E" range)
3. Generally $C_s = L_s \frac{V}{L}$ Cycle length (C_y) = seconds
4. $G = C_y\left(\frac{L}{CMS}\right)$ where CMS is critical movement summary of NCHRP bulletin 187 = sum of critical L's
5. Proportioning cycle time according to largest L (÷CMS) for each phase adjusting for minimum greens necessary for pedestrians, etc.
6. $C = \frac{G}{C_y} C_s$

APPROACH

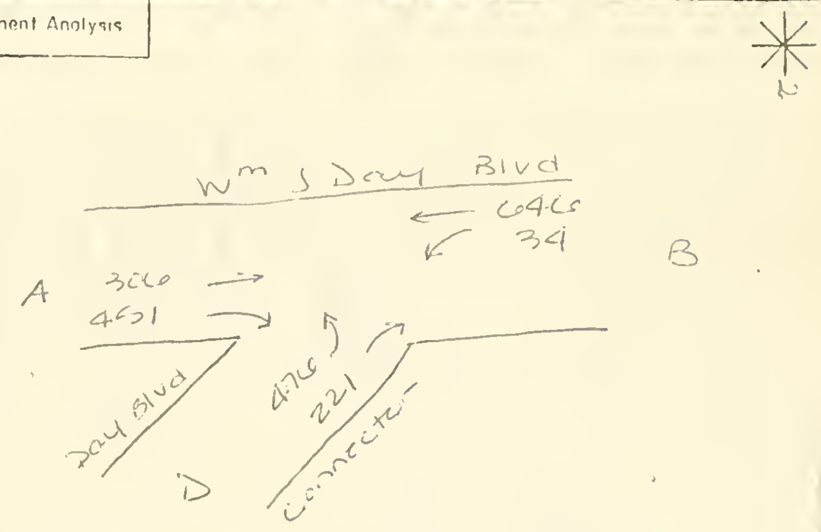
		(A)	(B)	(C)	(D)	(E)
APPROACH WIDTH	W					
PARKING	P					
LANES	M	2	2	-	2	
PHASE		P	Q	-	R	
HOURLY VOLUME	V	757	680	-	697	
CRITICAL LANE VOLUME (1)	L	416	374	-	383	
LANE CAPACITY/ HOUR GREEN (2)	L_S	1450	1450	-	1450	
APPROACH CAPACITY /HOUR GREEN (3)	C_S	2639	2636	-	2639	
DESIGN GREEN (4) (SECONDS)	G	35	33	-	32	
DESIGN GREEN/ CYCLE (5)	G/C_Y	.35	.33	-	.32	
APPROACH CAPACITY	C	924	870	-	844	
VOLUME CAPACITY	V/C	.82	.78	-	.83	

Project: Harbor Point

Intersection: Wm J Day Blvd
Day Blvd. Connector

SHEET OF SHEETS DATE:
Comp by: MBC Chkd by:
1990 Build R

Critical Movement Analysis



Identify Phasing	1	2	3	4	Intersection Level of Service
Direction	Net Approach Volume	Lane Use Factor	Lane Volume		Critical Movement Summation CMS
Wm J Day Blvd. (A)	757	.55	416		CMS =
Wm J Day Blvd. (B)	680	.55	374		CMS =
- (C)	--	-	-		CMS = Vehicles
Day Connector (D)	697	.55	383		
(F)					

	A	B	C	D	E
Net Through Volume	416	374	-	383	
Unprotected Left-Turn	-	-	-	-	
Opposing Left-Turn Volume	-	-	-	-	
TOTAL	416	374	-	383	

APPROACH LANES	LANE USE FACTOR
1	1.00
2	0.55
3	0.40
4	0.30

INTERSECTION CAPACITY BY LEVEL OF SERVICE

LEVEL OF SERVICE	RANGE OF CAPACITY (VPH) LOW	HIGH
A	0	900
B	901	1,050
C	1,051	1,200
D	1,201	1,350
E	1,351	1,500
F	(Special case)	1,500

DAY [illegible]
([illegible])

1990 8-HOUR
NO-IMPR [illegible]

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS

(see instructions following)

PROJECT NO.: ____________ ANALYST: ____________

SITE: ____________ DATE: ____________

LINE NO.	SYMBOL	INPUT/UNITS	TRAFFIC STREAM			
		BASIC INPUTS	EB	WB	NE	
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED (m s^{-1})	1.6	1.6	1.6	
3	θ	WIND-ROAD ANGLE (deg)	60	60	840	
4	x	LATERAL DISTANCE (m)	20	34	24	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	72	141	45	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	18	96	0	
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	
8	Qe	EXCESS EMISSIONS RATE (g m^{-1} s^{-1})	.016	.032	.033	
9	Qf	FREE FLOW EMISSIONS RATE (g m^{-1} s^{-1})	.006	.003	.003	
9a		STREET CANYON? YES OR NO	NO	NO	NO	
		DISPERSION ANALYSIS				
10	χUQ^{-1}	NORMALIZED CONCENTRATION (10^{-3} m^{-1}) FREE FLOW	580	420	140	
	Qf	ENTER LINE 9	x .006	x .003	x .003	x
11	χU	NORMALIZED CONCENTRATION (mg m^{-2} s^{-1})	3.48	1.26	0.42	
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷
12	χ	CO CONCENTRATION (mg m^{-3}) THROUGH EMISSIONS	2.175	0.788	0.263	
13	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	10	75	100	
	Qe	ENTER LINE 8	.016	.032	.033	
14	χU	NORMALIZED CONCENTRATION (mg m^{-2} s^{-1})	.16	2.4	3.3	
	U	ENTER LINE 2	1.6	1.6	1.6	
15	χ	CO CONCENTRATION "MAXIMUM QUEUE"	0.1	1.5	2.06	
16	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	0	10	0	
	Qe	ENTER LINE 8	x .016	x .032	x .033	x
17	χU	NORMALIZED CONCENTRATION (mg m^{-1} s^{-1})	0	0.32	0	
	U	ENTER LINE 2	1.6	1.6	1.6	
18	χ	CO CONCENTRATION "IMAGINARY QUEUE"	0	0.20	0	
19	χ	CO (mg m^{-3}) TOTAL	2.275	2.088	2.323	
20	χ	CO CONCENTRATION (ppm) TOTAL	2.0	1.82	2.02	
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^{+3})				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

5.84 + 1.2 = 7.04

(5.84 ÷ .7) = 8.34 + 2.2 = 10.54

Bell Blvd and Blvd Connector 1990 8-HOUR

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION
(see instructions following)

Project No.: 46 3 Analyst: M Chase

Site: Harbor Point Date: Sept. 1985

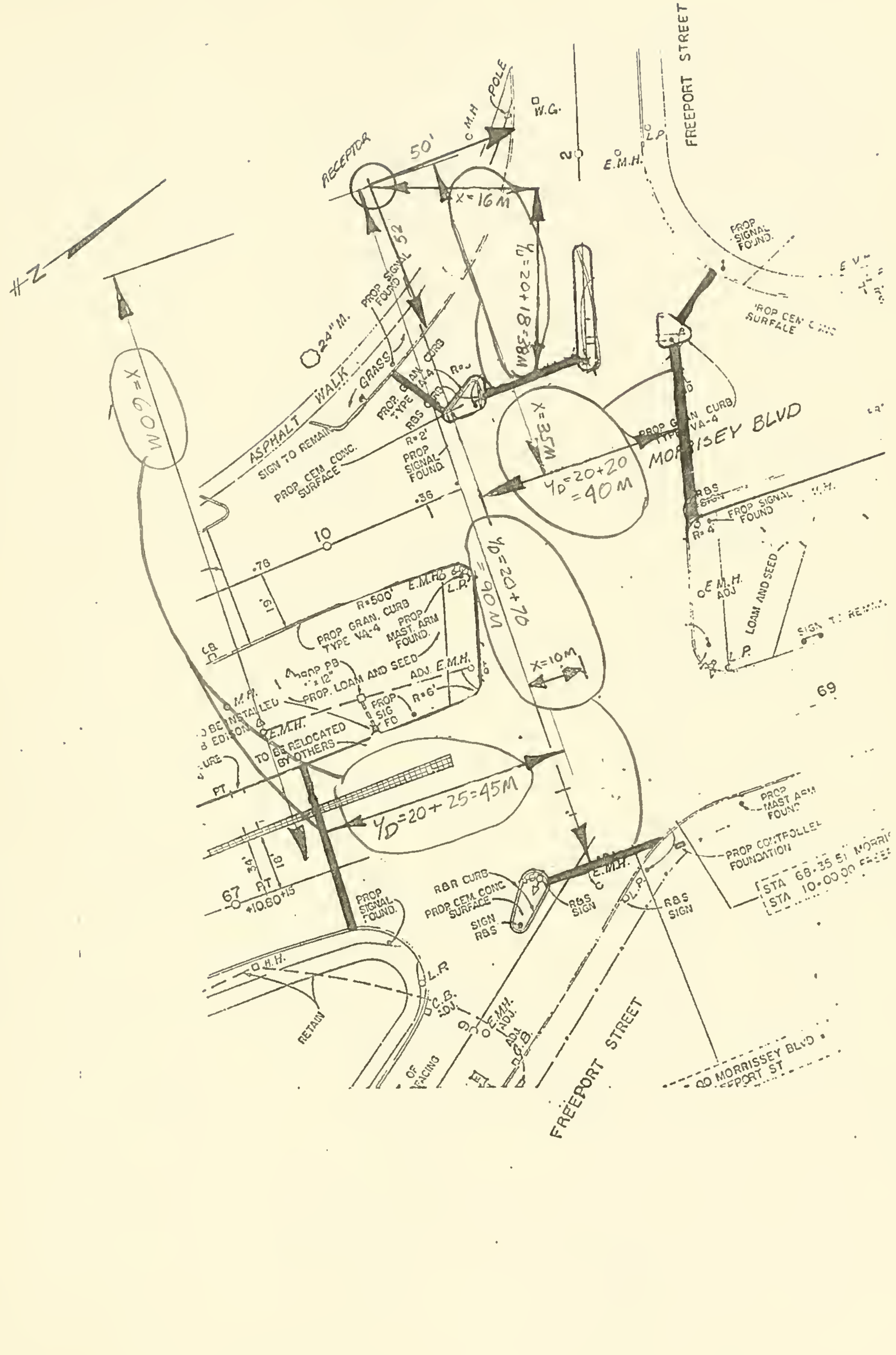
Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	EB	WB	NB	
2	V_i	Demand volume (vph)	797	680	697	
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	15	20	20	
5	Ef_i	Free-flow emissions (g/veh-m)	.028	.017	.017	
6.1	M_i	Number of lanes in approach i	2	2	2	
6.2	j	Signalized intersections phase identification	1	2	3	
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	2639	2636	2639	
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	797	680	697	
6.5	C_y	Signal cycle length (s)	100			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	35	33	32	
6.7	C_i	Capacity of approach i (vph)	924	870	844	
6.8	$P_{i,j}$	Proportion of vehicles that stop	.91 –	.91 –	.93 –	
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	20.2 –	17.2 –	18.0 –	
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	4.5	3.6	4.7	
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	54	45	49	
9	Rq_i	Average excess running time on approach (s/veh)	17.6	15.0	20.1	
10	Ea_i	emissions from acceleration (g/veh-m)	.165	.11	.11	
11	Ed_i	emissions from deceleration (g/veh-m)	.06	.038	.038	
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)	.045	.025	.027	
13	Lad_i	Length of acceleration and deceleration (m)	20.1	55.9	55.9	
14	Le_i	Length over which excess emissions apply (m)	54	45	49	
15	Fs_i	Average idling emission rate (g/s)	.279	.172	.266	
16	Qe	Average emission rate (g/m-s)	.022	.035	.036	
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.016	.032	.033	
18	Qfc_i	Free-flow emission rate (g/s-m)	.006	.003	.003	

17 a .022 .035 .036

b- .005 .002 .003

.016 .032 .033

MORRISSEY BLVD./FREEPORT STREET


FREEPORT STREET
MORRISSEY BLVD
RECEPTOR
50'
POLE
C.M.H.
W.G.
E.M.H.
L.P.
X=16M
Y_D=20+18=38M
PROP SIGNAL FOUND
52
X=60M
24"M.
ASPHALT WALK
GRASS
SIGN TO REMAIN
PROP CEM CONC SURFACE
PROP GRAN CURB TYPE VA-4
X=35M
Y_D=20+20 =40M
Y_D=20+70 =90M
R=500'
PROP MAST ARM FOUND.
PROP. LOAM AND SEED
ADJ. E.M.H.
X=10M
TO BE RELOCATED BY OTHERS
Y_D=20+25=45M
LOAM AND SEED
RBS SIGN
RBR CURB
PROP CONTROLLER FOUNDATION
STA 68+35.51 MORRISSEY
STA 10+00.00 FREEPORT
RETAIN
C.B. ADJ.
69
67
+10.80+15

1984 EXISTING

8hr AVG
1984 EXISTING

WORKSHEET 5 · INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

PROJECT NO.: 463 ANALYST: T. ERRICO
SITE: DORCHESTER DATE:

LINE NO.	SYMBOL	INPUT/UNITS	TRAFFIC STREAM			
		BASIC INPUTS	FE	FW	MS	MN
1	SC	STABILITY CLASS	D	D	D	D
2	U	WIND SPEED (m s^{-1})	1.6	1.6	1.6	1.6
3	θ	WIND ROAD ANGLE (deg)	84°	84°	6°	6°
4	x	LATERAL DISTANCE (m)	15	10	35	60
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	38	96	96	70
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	7	70	40	45
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	5
8	Qe	EXCESS EMISSIONS RATE (g m^{-1} s^{-1})	.0498	.0413	.1693	.1074
9	Qf	FREE FLOW EMISSIONS RATE (g m^{-1} s^{-1})	.0027	.0022	.0093	.0028
9a		STREET CANYON? YES OR NO	No	No	No	No
		DISPERSION ANALYSIS				
10	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (10^{-3} m^{-1}) FREE FLOW	145	155	405	280
	Qf	ENTER LINE 9	× .0027	× .0022	× .0093	× .0028
11	χU	NORMALIZED CONCENTRATION (mg m^{-2} s^{-1})	.3915	.341	3.8	.784
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷ 1.6
12	χ	CO CONCENTRATION (mg m^{-3}) THROUGH EMISSIONS	.3	.2	2.4	.5
13	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yu)	135	150	8	0
	Qe	ENTER LINE 8	.0498	.0413	.1693	.1074
14	χU	NORMALIZED CONCENTRATION (mg m^{-2} s^{-1})	6.7	6.2	1.4	0
	U	ENTER LINE 2	1.6	1.6	÷ 1.6	÷ 1.6
15	χ	CO CONCENTRATION "MAXIMUM QUEUE"	4.2	3.9	.9	0
16	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yd)	15	150	0	0
	Qe	ENTER LINE 8	× .0498	× .0413	× .1693	× .1074
17	χU	NORMALIZED CONCENTRATION (mg m^{-1} s^{-1})	-.8	-6.2	0	0
	U	ENTER LINE 2	1.6	1.6	1.6	1.6
18	χ	CO CONCENTRATION "IMAGINARY QUEUE"	-.5	-3.9	0	0
19	χ	CO (mg m^{-3}) TOTAL	4	.2	3.3	.5
20	χ	CO CONCENTRATION (ppm) · TOTAL .87	3.5	.2	2.9	.4
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^{+3})				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

8Hr (CO) = 7.0 + 1.5 = 8.5 ppm

1Hr (CO) = 7.0 ÷ .7 = 10 + 3 = 13.0 ppm

& FREEPORT ST.
1984 EXISTING
8hr AVG.

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION
(see instructions following)

Project No.: 463 Analyst: T. ERRICO

Site: Dorchester Date:

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	FE	FW	MS	MN
2	V_i	Demand volume (vph)	413	322	2093	637
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	30	30	40	40
5	Ef_i	Free-flow emissions (g/veh-m)	.024	.024	.016	.016
6.1	N_i	Number of lanes in approach i	2	2	4	4
6.2	j	Signalized intersections phase identification	A	B	C	D
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	2638	2638	4833	4836
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	413	322	2093	637
6.5	C_y	Signal cycle length (s)	100			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	19	15	51	15
6.7	C_i	Capacity of approach i (vph)	501	396	2465	725
6.8	$P_{i,j}$	Proportion of vehicles that stop	.96	.97	.86	.98
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	11.0	8.7	50.0	17.3
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	4.7	4.4	5.6	7.2
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	31	26	56	25
9	Rq_i	Average excess running time on approach (s/veh)	73	81	29	77
10	Ea_i	emissions from acceleration (g/veh-m)	.10	.10	.091	.091
11	Ed_i	emissions from deceleration (g/veh-m)	.031	.031	.027	.027
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)	.0144	.0114	.059	.0204
13	Lad_i	Length of acceleration and deceleration (m)	80.5	80.5	143	143
14	Le_i	Length over which excess emissions apply (m)	40	40	56	40
15	Fs_i	Average idling emission rate (g/s)	.9377	.8184	1.489	1.489
16	Qe	Average emission rate (g/m-s)	.0524	.0434	.1773	.1102
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.0498	.0413	.1693	.1074
18	Qfc_i	Free-flow emission rate (g/s-m)	.0027	.0022	.0093	.0028

17a	.0524	.0434	.1773	.1102
17b -	.0026	.0021	.0080	.0028
	.0498	.0413	.1693	.1074

1990

INTERSECTION DATA FOR AIR QUALITY ANALYSIS - WORK SHEET

THE MEANING OF THE V/C RESULTS

V/C	IMPLICATIONS
0.70 and below......	No congestion expected
0.80................	Congestion very unlikely
0.90................	Some delays encountered; some congestion during peak events or bad weather
1.00................	Some congestion will be encountered during the peak hour
1.20 and above......	Congestion will extend beyond the peak hour unless traffic travels at other times, involves more transit/shared ride, or trips aren't made (less development; more building vacancies).

NOTES

1. As described in NCHRP bulletin 187
2. LS = 1450 vph (NCHRP bulletin 187 LOS "E" range)
3. Generally $C_s = L_s \frac{G}{C}$ Cycle length (C_y) = seconds
4. $G = Cy \left(\frac{L}{CMS}\right)$ where CMS is critical movement summary of NCHRP bulletin 187 = sum of critical L's
5. Proportioning cycle time according to largest L (FCMS) for each phase adjusting for minimum greens necessary for pedestrians, etc.
6. $C = \frac{G}{C_y} C_s$

APPROACH

		(A)	(B)	(C)	(D)	(E)
APPROACH WIDTH	N					
PARKING	P					
LANES	M	2	2	4	4	
PHASE		P	Q	R	S	
HOURLY VOLUME	V	563	374	2652	667	
CRITICAL LANE VOLUME (1)	L	277	206	766	200	
LANE CAPACITY/HOUR GREEN (2)	L_s	1600	1600	1600	1600	
APPROACH CAPACITY/HOUR GREEN (3)	C_s	2905	2905	5331	5336	
DESIGN GREEN (4) (SECONDS)	G	19	14	63	14	
DESIGN GREEN/CYCLE (5)	G/C_Y	.19	.14	.63	.14	
APPROACH CAPACITY	C	552	407	2825	747	
VOLUME CAPACITY	V/C	.91	.92	.90	.89	

Project: Harbor Point

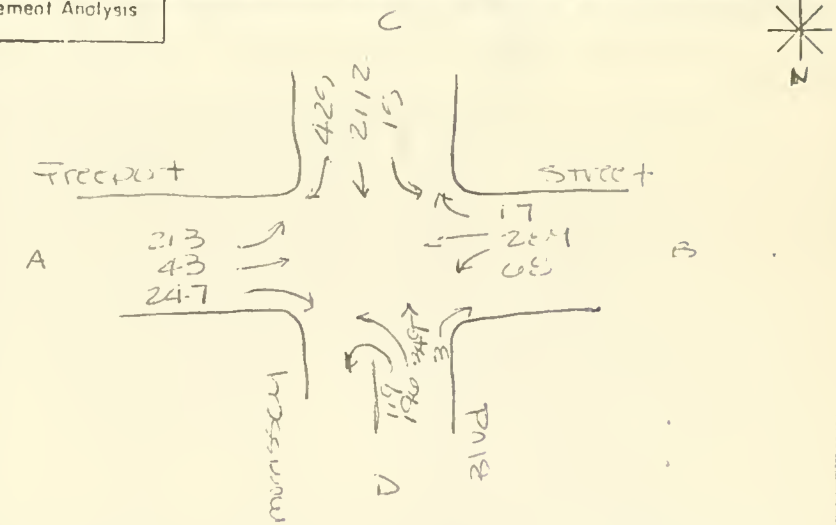
Intersection: Freeport Street / Morrissey Blvd.

SHEET OF SHEETS DATE:

Comp by: MRC Chkd by:

1990 E-Hour

Critical Movement Analysis



Identify Phasing	1	2	3	4

Direction	Net Approach Volume	Lane Use Factor	Lane Volume
Freeport St. (A)	563	.55	277
Freeport St. (B)	374	.55	206
Morrissey Blvd (C)	2552	.30	766
Morrissey Blvd (D)	667	.30	200
(F)			

	A	B	C	D	E
Net Through Volume	277	206	766	200	
Unprotected Left-Turn	—	—	—	—	
Opposing Left-Turn Volume	—	—	—	—	
TOTAL	277	206	766	200	

Intersection Level of Service

Critical Movement Summation CMS

CMS =

CMS =

CMS = Vehicles

Freeport Street /
Morrissey Blvd.
1990 8 Hour

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION
(see instructions following)

Project No.: 4103 Analyst: M. Chase

Site: Harbor Point Date: Sept. 1986

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	FE	FW	MS	MN
2	V_i	Demand volume (vph)	503	374	2552	667
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	30	30	40	40
5	Ef_i	Free-flow emissions (g/veh-m)	.014	.014	.009	.009
6.1	M_i	Number of lanes in approach i	2	2	4	4
6.2	j	Signalized intersections phase identification	P	Q	R	S
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	2900	2900	5331	5336
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	503	374	2552	667
6.5	C_y	Signal cycle length (s)	100			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	19	14	53	14
6.7	C_i	Capacity of approach i (vph)	552	407	2825	747
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.98	0.99	0.90	0.98
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	13.7	10.3	0.6	18.2
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	10.3	11.3	9.3	8.3
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	62	47	11	29
9	Rq_i	Average excess running time on approach (s/veh)	107	143	330	62.1
10	Ea_i	emissions from acceleration (g/veh-m)	.100	.100	.091	.091
11	Ed_i	emissions from deceleration (g/veh-m)	.031	.031	.026	.026
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)	.018	.013	.001	.021
13	Lad_i	Length of acceleration and deceleration (m)	80.5	80.5	143.0	143.0
14	Le_i	Length over which excess emissions apply (m)	52	47	40	40
15	Fs_i	Average idling emission rate (g/s)	1.284	1.295	1.613	1.249
16	Qe	Average emission rate (g/m-s)	.053	.050	.044	.106
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.051	.049	.044	.104
18	Qfc_i	Free-flow emission rate (g/s-m)	.002	.001	.000	.002

17a	.053	.050	.044	.106
− 17b	.002	.001	.000	.002
	.051	.049	.044	.104

1990 8 Hour

WORKSHEET 5 INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

PROJECT NO.: ______________________ ANALYST: ______________________

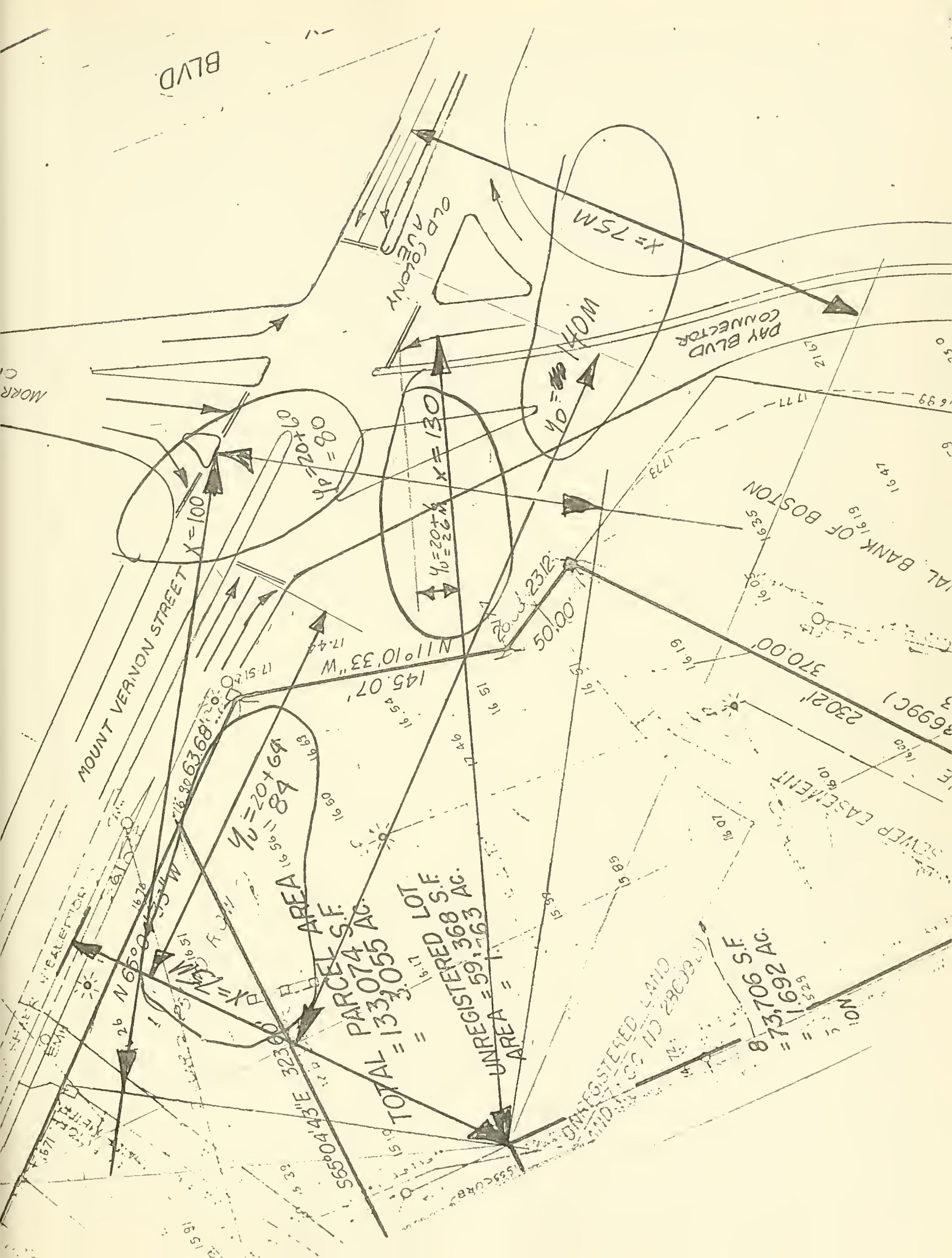
SITE: ______________________ DATE: ______________________

LINE NO.	SYMBOL	INPUT/UNITS	TRAFFIC STREAM			
		BASIC INPUTS	FE	FW	MS	MN
1	SC	STABILITY CLASS	D	D	D	D
2	U	WIND SPEED ($m\ s^{-1}$)	1.6	1.6	1.6	1.6
3	θ	WIND-ROAD ANGLE (deg)	84°	84°	6°	6°
4	x	LATERAL DISTANCE (m)	15	10	35	60
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	59	117	51	74
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	7	70	40	45
7	σ_{z_0}	INITIAL DISPERSION (m)	5	3	5	5
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.051	.049	.044	.104
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.032	.001	[illegible]	.002
9a		STREET CANYON? YES OR NO	NO	NO	NO	[illegible]
		DISPERSION ANALYSIS				
10	χUQ^{-1}	NORMALIZED CONCENTRATION ($10^3\ m^{-1}$) FREE FLOW	145	155	405	280
	Qf	ENTER LINE 9	× .032	× .001	× [illegible]	× .002
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	.79	0.155	2.43	0.56
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷ 1.6
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	0.18	0.10	1.52	0.35
13	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	150	150	0	0
	Qe	ENTER LINE 8	.051	.049	.044	.104
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	7.65	7.35	0	0
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷ 1.6
15	χ	CO CONCENTRATION—"MAXIMUM QUEUE"	4.78	4.6	0	0
16	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	15	150	0	0
	Qe	ENTER LINE 8	× .051	× .049	× .044	× .104
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	0.765	7.35	0	0
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷ 1.6
18	χ	CO CONCENTRATION—"IMAGINARY QUEUE"	0.48	4.6	0	0
19	χ	CO ($mg\ m^{-3}$) TOTAL	4.48	0.10	1.52	0.35
20	χ	CO CONCENTRATION (ppm)—TOTAL	3.9	0.09	1.32	0.30
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^{+3})				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

8 Hr = 5.61 + 1.2 = 6.81

1 Hr = (5.61 ÷ .7) + 2.4 = 10.41

Day Blvd. Connector/ Mt. Vernon Street/Morrisey Blvd.



BLVD
OLD COLONY AVE
DAY BLVD CONNECTOR
MOUNT VERNON STREET
BANK OF BOSTON
SEWER EASEMENT
X= 75M
X = 130
X=100
N 11°10'33" W
145.07'
50.00'
370.00'
230.21'
TOTAL PARCEL AREA = 133,074 S.F. = 3.055 AC.
UNREGISTERED LOT AREA = 59,368 S.F. = 1.363 AC.
= 73,706 S.F. = 1.692 AC.
S65°04'43"E 323.60

1984 EXISTING

INTERSECTION DATA FOR AIR QUALITY ANALYSIS - WORK SHEET

THE MEANING OF THE V/C RESULTS

V/C	IMPLICATIONS
0.70 and below......	No congestion expected
0.80................	Congestion very unlikely
0.90................	Some delays encountered; some congestion during peak events or bad weather
1.00................	Some congestion will be encountered during the peak hour
1.20 and above......	Congestion will extend beyond the peak hour unless traffic travels at other times, involves more transit/shared ride, or trips aren't made (less development; more building vacancies).

NOTES:

1. As described in NCHRP bulletin 137
2. LS = 1450 vph (NCHRP bulletin 137 LOS "E" range)
3. Generally $C_s = L_s \frac{V}{L}$ ... length (C_y) = seconds
4. $G = cy\left(\frac{L}{CMS}\right)$ where CMS is critical movement summary of NCHRP bulletin 137 = sum of critical L's
5. Proportioning cycle time according to largest L (ΣCMS) for each phase adjusting for minimum greens necessary for pedestrians, etc.
6. $C = \frac{G}{C_y} C_s$

APPROACH

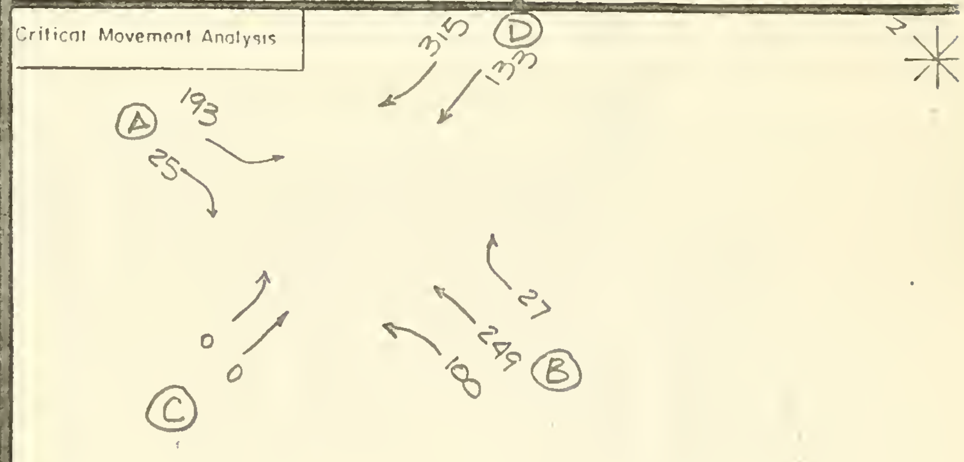
		(A)	(B)	(C)	(D)	(E)
APPROACH WIDTH	N					
PARKING	P					
LANES	M	2	2	2	2	
PHASE		P			Q	
HOURLY VOLUME	V	193	276	0	448	
CRITICAL LANE VOLUME (1)	L	299	152	0	246	
LANE CAPACITY/ HOUR GREEN (2)	L_s	1450	1450	0	1450	
APPROACH CAPACITY /HOUR GREEN (3)	C_s	936	2633	0	2641	
DESIGN GREEN (4) (SECONDS)	G	55		0	45	
DESIGN GREEN/ CYCLE (5)	G/C_y	.55	.55	0	.45	
APPROACH CAPACITY	C	515	1448	0	1189	
VOLUME CAPACITY	V/C	.37	.19	0	.38	

SHEET OF SHEETS DATE:
Comp by: Chkd by:

1984 EXISTING
8hr AVG

Project: COLUMBIA Point
Intersection: Mt Vernon - Morrissey Blvd. off Ramp - old Colony Ave - Day Blvd Connector

Critical Movement Analysis



Identify Phasing	1	2	3	4	Intersection Level of Service

Direction	Net Approach Volume	Lane Use Factor	Lane Volume
Day Connector (A)	193	.55	106
Morrissey Ramp (B)	276	.55	152
old Colony (C)	0	0	0
Mt. Vernon (D)	448	.55	246
(F)			

	A	B	C	D	E
Net Through Volume	106	152	0	246	
Unprotected Left-Turn	193	–	0	–	
Opposing Left-Turn Volume	–	–	0	–	
TOTAL	299	152	0	246	

Critical Movement Summation CMS

CMS =

CMS =

CMS = Vehicles

PM PEAK 1984 EXISTING
MORRISSEY BLVD & MT VERNON
8 hr. AVG.

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION
(see instructions following)

Project No.: 463 Analyst: T ERRICO

Site: Dorchester Date:

Step	Symbol	Input/Units	Traffic Stream					
1	i	Road segment (or approach identification)	MS	MN	VW			
2	V_i	Demand volume (vph)	193	276	448			
3	C_i	Free-flow capacity (vph)						
4	S_i	Cruise speed (mph)	20	30	30			
5	Ef_i	Free-flow emissions (g/veh-m)	.039	.022	.022			
6.1	M_i	Number of lanes in approach i	2	2	2			
6.2	j	Signalized intersections phase identification	A	A	B			
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	936	2633	2641			
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	193	276	448			
6.5	C_y	Signal cycle length (s)	100					
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	55 -	55 -	45 -			
6.7	C_i	Capacity of approach i (vph)	515	1448	1189			
6.8	$P_{i,j}$	Proportion of vehicles that stop	.57 -	.50 -	.66			
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	3.06	3.83	8.21			
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	.60	.24	.60			
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	8.0	8.9	19.2			
9	Rq_i	Average excess running time on approach (s/veh)	17.0	11.85	20.0			
10	Ea_i	emissions from acceleration (g/veh-m)	.13	.01	.01			
11	Ed_i	emissions from deceleration (g/veh-m)	.045	.031	.031			
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)	.0054	.0016	.0034			
13	Lad_i	Length of acceleration and deceleration (m)	35.8	80.5	80.5			
14	Le_i	Length over which excess emissions apply (m)	40	40	40			
15	Fs_i	Average idling emission rate (g/s)	.0850	.0547	.2126			
16	Qe	Average emission rate (g/m-s)	.0070	.0046	.0122			
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.0058	.0038	.0104			
18	Qfc_i	Free-flow emission rate (g/s-m)	.0021	.0017	.0027			

17a .0070 .0046 .0122

17b - .0012 .00084 .0018

.0058 .0038 0.0104

MORRISSEY BLVD & MT. VERNON

8hr AVG

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS

(see instructions following)

PROJECT NO. 463 ANALYST: TERRICO

SITE: DORCHESTER DATE:

LINE NO.	SYMBOL	INPUT/UNITS	TRAFFIC STREAM			
		BASIC INPUTS	MS	MN	VW	
1	SC	STABILITY CLASS	D	D	D	
2	U	WIND SPEED (m s^{-1})	1.0	1.0	1.0	
3	θ	WIND-ROAD ANGLE (deg)	84°	84°	6°	
4	x	LATERAL DISTANCE (m)	130	100	75	
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	26	90	84	
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	17	80	62	
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	
8	Qe	EXCESS EMISSIONS RATE (g m^{-1} s^{-1})	.0058	.0038	.0104	
9	Qf	FREE FLOW EMISSIONS RATE (g m^{-1} s^{-1})	.0021	.0017	.0027	
9a		STREET CANYON? YES OR NO	No	No	No	
		DISPERSION ANALYSIS				
10	χUQ^{-1}	NORMALIZED CONCENTRATION (10^{-3} m^{-1}) FREE FLOW	85	90	240	
	Qf	ENTER LINE 9	x .0021	x .0017	x .0027	x
11	χU	NORMALIZED CONCENTRATION (mg m^{-2} s^{-1})	.1785	.153	.648	
	U	ENTER LINE 2	÷ 1.0	÷ 1.0	÷ 1.0	÷
12	χ	CO CONCENTRATION (mg m^{-3}) THROUGH EMISSIONS	.2	.2	.7	
13	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	35	90	0	
	Qe	ENTER LINE 8	.0058	.0038	.0104	
14	χU	NORMALIZED CONCENTRATION (mg m^{-2} s^{-1})	.2	.3	0	
	U	ENTER LINE 2	1.0	1.0	1.0	
15	χ	CO CONCENTRATION - "MAXIMUM QUEUE"	.2	.3	0	
16	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	0	90	0	
	Qe	ENTER LINE 8	x .0058	x .0038	x .0104	x
17	χU	NORMALIZED CONCENTRATION (mg m^{-1} s^{-1})	0	.3	0	
	U	ENTER LINE 2	1.0	÷ 1.0	1.0	
18	χ	CO CONCENTRATION "IMAGINARY QUEUE"	0	.3	0	
19	χ	CO (mg m^{-3}) TOTAL	.4	.8	.7	
20	χ	CO CONCENTRATION (ppm) TOTAL	.4	.7	.6	
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^{+3})				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

8HR (CO) = 1.7 + 3.0 = 3.7 ppm

1HR (CO) = 1.7 x .7 = 1.2 + 1.5 = 2.7 ppm

INTERSECTION DATA FOR AIR QUALITY ANALYSIS - WORK SHEET

THE MEANING OF THE V/C RESULTS

V/C	IMPLICATIONS
0.70 and below......	No congestion expected
0.80................	Congestion very unlikely
0.90................	Some delays encountered; some congestion during peak events or bad weather
1.00................	Some congestion will be encountered during the peak hour
1.20 and above......	Congestion will extend beyond the peak hour unless traffic travels at other times, involves more transit/shared ride, or trips aren't made (less development; more building vacancies).

NOTES

1. As described in NCHRP bulletin 187
2. LS = 1450 vph (NCHRP bulletin 187 LOS "E" range)
3. Generally $C_s = L_s \frac{V}{L}$ Cycle length (C_y) = 100 seconds
4. $G = cy\ (\frac{L}{cms})$ where CMS is critical movement summary of NCHRP bulletin 187 = sum of critical L's
5. Proportioning cycle time according to largest L (÷CMS) for each phase adjusting for minimum greens necessary for pedestrians, etc.
6. $C = \frac{G}{C_y} C_s$

APPROACH

		(A)	(B)	(C)	(D)	(E)
APPROACH WIDTH	W					
PARKING	P					
LANES	M	2	2	2	2	
PHASE		P			Q	
HOURLY VOLUME	V	227	325	0	526	
CRITICAL LANE VOLUME (1)	L	352	179	0	289	
LANE CAPACITY/ HOUR GREEN (2)	L_s	1450	1450	0	1450	
APPROACH CAPACITY /HOUR GREEN (3)	C_s	935	2633	0	2639	
DESIGN GREEN (4) (SECONDS)	G	55		0	45	
DESIGN GREEN/ CYCLE (5)	G/C_y	.55	.55	0	.45	
APPROACH CAPACITY	C	514	1448	0	1188	
VOLUME CAPACITY	V/C	.44	.22	0	.44	

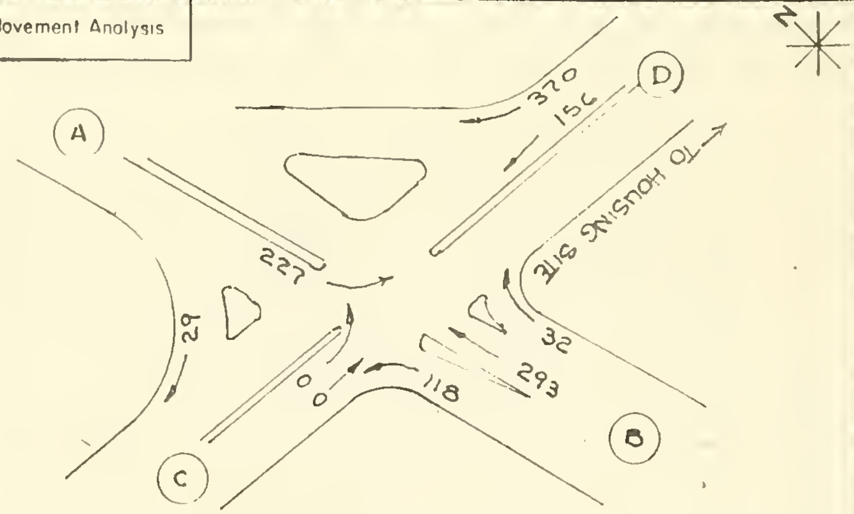
BOSTON REDEVELOPMENT AUTHORITY
TRANSPORTATION PLANNING DEPARTMENT

Project: COLUMBIA POINT

Intersection: Mt Vernon-Morrissey Blvd off Ramp-old Colony Ave - Day Blvd Connector

SHEET OF SHEETS DATE:
Comp by: Chkd by:
AM/ PM/ ~~OFF PEAK~~ EXIST/ ~~PROP~~
1984 Existing 4:00-5:00PM

Critical Movement Analysis



Identify	1	2	3	4	Intersection Level of Service A
Phasing					

Direction	Net Approach Volume	Lane Use Factor	Lane Volume
Day Connector (A)	227	.55	125
Morrissey Ramp (B)	325	.55	179
old Colony (C)	0	0	0
Mt Vernon (D)	526	.55	289
(E)			

	A	B	C	D	E
Net Through Volume	125	179	0	289	
Unprotected Left-Turn	227	-	0	-	
Opposing Left-Turn Volume	-	-	0	-	
TOTAL	352	179	0	289	

Critical Movement Summation CMS

CMS = A+D
CMS = 352 + 289
CMS = 641 Vehicles

APPROACH LANES	LANE-USE FACTOR
1	1.00
2	0.55
3	0.40
4	0.30

INTERSECTION CAPACITY BY LEVEL OF SERVICE

LEVEL OF SERVICE	LIMITS OF CAPACITY (VPH) LOW	HIGH
A	0	900
B	901	1,050
C	1,051	1,200
D	1,201	1,350
E	1,351	1,500
F	(Special case)	1,500

1990 ALTERNATIVE A

INTERSECTION DATA FOR AIR QUALITY ANALYSIS - WORK SHEET

THE MEANING OF THE V/C RESULTS

V/C	IMPLICATIONS
0.70 and below......	No congestion expected
0.80................	Congestion very unlikely
0.90................	Some delays encountered; some congestion during peak events or bad weather
1.00................	Some congestion will be encountered during the peak hour
1.20 and above......	Congestion will extend beyond the peak hour unless traffic travels at other times, involves more transit/shared ride, or trips aren't made (less development; more building vacancies).

NOTES

1. As described in NCHRP bulletin 187
2. LS = 1450 vph (NCHRP bulletin 187 LOS "E" range)
3. Generally $C_s = L_s \frac{V}{L}$ Cycle length (C_y) = seconds
4. $G = cy\left(\frac{L}{CMS}\right)$ where CMS is critical movement summary of NCHRP bulletin 187 = sum of critical L's
5. Proportioning cycle time according to largest L (÷CMS) for each phase adjusting for minimum greens necessary for pedestrians, etc.
6. $C = \frac{G}{C_y} C_s$

APPROACH

		(A)	(B)	(C)	(D)	(E)
APPROACH WIDTH	W					
PARKING	P					
LANES	M	1	1	1	1	
PHASE		—	7	Q	—	
HOURLY VOLUME	V	85	170	485	183	
CRITICAL LANE VOLUME (1)	L	47	170	485	183	
LANE CAPACITY/ HOUR GREEN (2)	L_s	1450	1450	1450	1450	
APPROACH CAPACITY /HOUR GREEN (3)	C_s	2022	1450	1450	1450	
DESIGN GREEN (4) (SECONDS)	G	.26	.26	.74	.74	
DESIGN GREEN/ CYCLE (5)	G/C_Y	.26	.26	.74	.74	
APPROACH CAPACITY	C	682	377	1073	1073	
VOLUME CAPACITY	V/C	.12	.45	.45	.17	

Project: Harbor Point

Intersection: Day Blvd Connect. Mt. Vernon St.

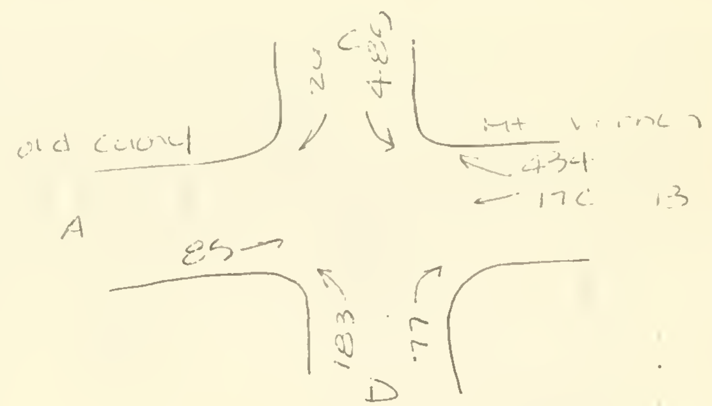
SHEET OF SHEETS DATE:

Comp by: MBX Chkd by:

1990 0 Hour

Alt. A

Critical Movement Analysis



Identify / Phasing	1	2	3	4

Direction	Net Approach Volume	Lane Use Factor	Lane Volume
Old Colony (A)	85	.55	47
Mt. Vernon (B)	170	1.0	170
Day Conn. (C)	485	1.0	485
Morrissey (D)	183	1.0	183
(E)			

	A	B	C	D	E
Net Through Volume	47	170	485	183	
Unprotected Left-Turn	—	—	—	—	
Opposing Left-Turn Volume	—	—	—	—	
TOTAL	47	170	485	183	

Intersection Level of Service

Critical Movement Summation CMS

CMS =

CMS =

CMS = Vehicles

MT. VERNON
1990 8-HOUR

WORKSHEET 5 · INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

PROJECT NO.: ____________ ANALYST: ____________

SITE: ____________ DATE: ____________

LINE NO.	SYMBOL	INPUT/UNITS	TRAFFIC STREAM			
		BASIC INPUTS	EB	WB	SB	NB
1	SC	STABILITY CLASS	D	D	D	D
2	U	WIND SPEED ($m\ s^{-1}$)	1.6	1.6	1.6	1.6
3	θ	WIND-ROAD ANGLE (deg)	6°	6°	84°	84°
4	x	LATERAL DISTANCE (m)	75	75	130	100
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	148	56	27	87
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	140	35	0	80
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	5
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.004	.013	.008	.004
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.001	.001	.003	.001
9a		STREET CANYON? YES OR NO	NO	NO	NO	NO
		DISPERSION ANALYSIS				
10	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	240	240	85	90
	Qf	ENTER LINE 9	× .001	× .001	× .003	× .001
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	.24	.24	.255	.09
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷ 1.6
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	0.15	0.15	.16	.056
13	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yu)	5	0	25	100
	Qe	ENTER LINE 8	.004	.013	.008	.004
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	.02	0	.2	.4
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷ 1.6
15	χ	CO CONCENTRATION "MAXIMUM QUEUE"	0.012	0	.125	.25
16	$\chi U Q^{-1}$	NORMALIZED CONCENTRATION (FOR Yd)	0	0	0	90
	Qe	ENTER LINE 8	× .004	× .013	× .008	× .004
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	0	0	0	.36
	U	ENTER LINE 2	1.6	1.6	1.6	1.6
18	χ	CO CONCENTRATION "IMAGINARY QUEUE"	0	0	0	.225
19	χ	CO ($mg\ m^{-3}$) TOTAL	.0163	0.15	.285	.081
20	χ	CO CONCENTRATION (ppm) · TOTAL	0.14	0.13	.25	.07
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^{+3})				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

8 HR = 0.59 + 1.2 = 1.79

1 HR = (0.59 ÷ .7) + 2.4 = 3.24

1990 ALTERNATIVE B

Day Blvd Conn. / Mt. Vernon
1990 8-Hour
Alt. A

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION
(see instructions following)

Project No.: 4-163 Analyst: M Chase
Site: Harbor Point Date: Sept. 1985

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	EB	NB	SB	WB
2	V_i	Demand volume (vph)	85	170	485	183
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	20	30	20	30
5	Ef_i	Free-flow emissions (g/veh-m)	.022	.014	.022	.014
6.1	M_i	Number of lanes in approach i	1	1	1	1
6.2	j	Signalized intersections phase identification	P	P	G	G
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	2622	1450	1450	1450
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	85	170	485	183
6.5	C_y	Signal cycle length (s)	100			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	26	26	74	74
6.7	C_i	Capacity of approach i (vph)	682	377	1073	1073
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.76	0.84	0.39	0.30
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	1.8	4.0	5.3	1.5
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	0.1	0.8	0.8	0.2
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	8	21	27	7
9	Rq_i	Average excess running time on approach (s/veh)	28.6	38.7	7.8	4.6
10	Ea_i	emissions from acceleration (g/veh-m)	.130	.100	.130	.100
11	Ed_i	emissions from deceleration (g/veh-m)	.045	.031	.045	.031
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)	.003	.005	.009	.002
13	Lad_i	Length of acceleration and deceleration (m)	35.8	80.5	35.8	80.5
14	Le_i	Length over which excess emissions apply (m)	40	40	40	40
15	Fs_i	Average idling emission rate (g/s)	.053	.141	.047	0
16	Qe	Average emission rate (g/m-s)	.004	.014	.009	.004
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.004	.013	.008	.004
18	Qfc_i	Free-flow emission rate (g/s-m)	.001	.001	.003	.001

17a .004 .014 .009 .004
− 17b .000 .001 .001 .000
.004 .013 .008 .004

INTERSECTION DATA FOR AIR QUALITY ANALYSIS - WORK SHEET

THE MEANING OF THE V/C RESULTS

V/C	IMPLICATIONS
0.70 and below	No congestion expected
0.80	Congestion very unlikely
0.90	Some delays encountered; some congestion during peak events or bad weather
1.00	Some congestion will be encountered during the peak hour
1.20 and above	Congestion will extend beyond the peak hour unless traffic travels at other times, involves more transit/shared ride, or trips aren't made (less development; more building vacancies).

NOTES

1. As described in NCHRP bulletin 137
2. LS = 1450 vph (NCHRP bulletin 137 LOS "E" range)
3. Generally $C_s = L_s \frac{V}{L}$ Cycle length (C_y) = seconds
4. $G = cy \left(\frac{L}{CMS}\right)$ where CMS is critical movement summary of NCHRP bulletin 137 = sum of critical L's
5. Proportioning cycle time according to largest L (÷CMS) for each phase adjusting for minimum greens necessary for pedestrians, etc.
6. $C = \frac{G}{C_y} C_s$

APPROACH

		A	B	C	D	E
APPROACH WIDTH	W					
PARKING	P					
LANES	M	2	2	1	1	
PHASE		–	R	S	–	
HOURLY VOLUME	V	85	604	485	366	
CRITICAL LANE VOLUME (1)	L	47	332	485	366	
LANE CAPACITY/HOUR GREEN (2)	L_s	1450	1450	1450	1450	
APPROACH CAPACITY /HOUR GREEN (3)	C_s	2622	2638	1450	1450	
DESIGN GREEN (4) (SECONDS)	G	41	41	59	59	
DESIGN GREEN/CYCLE (5)	G/C_Y	.41	.41	.59	.59	
APPROACH CAPACITY	C	1075	1082	856	856	
VOLUME CAPACITY	V/C	.08	.56	.57	.43	

Project: Harbor Point

Intersection: Day Blvd. Connector Mt. Vernon Street

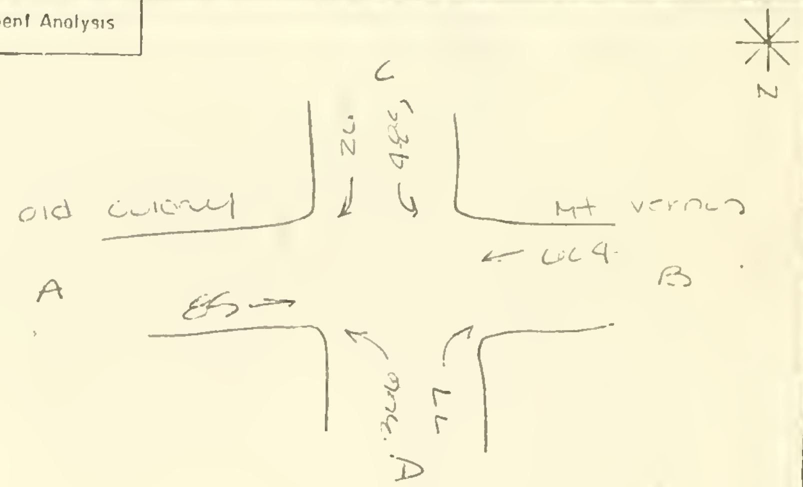
SHEET OF SHEETS DATE:

Comp by: MBK Chkd by:

CGL B-HOUR

Alt. B

Critical Movement Analysis



Identify Phasing	1	2	3	4	Intersection Level of Service

Direction		Net Approach Volume	Lane Use Factor	Lane Volume	Critical Movement Summation CMS
Old Colony	A	85	.55	47	CMS =
Mt. Vernon	B	604	.55	332	CMS =
Day Conn.	C	485	1.0	485	CMS = Vehicles
Morrissey	D	366	1.0	366	
	E				

	A	B	C	D	E
Net Through Volume	47	332	485	366	
Unprotected Left-Turn	–	–	–	–	
Opposing Left-Turn Volume	–	–	–	–	
TOTAL	47	332	485	366	

INTERSECTION CAPACITY BY LEVEL OF SERVICE

Dean Blvd Conn./
Mt. Vernon St.
1990 8-HOUR
Alt. 13

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION
(see instructions following)

Project No.: 4103 Analyst: M. Chase

Site: Harbor Point Date: Sept. 1985

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	EB	WB	SB	NB
2	V_i	Demand volume (vph)	85	604	485	366
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	20	30	20	30
5	Ef_i	Free-flow emissions (g/veh-m)	.022	.014	.022	.014
6.1	M_i	Number of lanes in approach i	2	2	1	1
6.2	j	Signalized intersections phase identification	R	R	S	S
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	2622	2638	1450	1450
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	85	604	485	366
6.5	C_y	Signal cycle length (s)	100			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	41	41	59	59
6.7	C_i	Capacity of approach i (vph)	1075	1082	856	856
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.61	0.77	0.62	0.55
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	1.4	12.9	8.4	5.6
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	0.1	1.3	1.3	0.7
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	3	31	42	27
9	Rq_i	Average excess running time on approach (s/veh)	18.3	27.0	18.1	14.2
10	Ea_i	emissions from acceleration (g/veh-m)	.130	.100	.130	.100
11	Ed_i	emissions from deceleration (g/veh-m)	.045	.031	.045	.031
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)	.002	.017	.015	.007
13	Lad_i	Length of acceleration and deceleration (m)	35.8	80.5	35.8	80.5
14	Le_i	Length over which excess emissions apply (m)	40	40	42	40
15	Fs_i	Average idling emission rate (g/s)	.031	.321	.173	.076
16	Qe	Average emission rate (g/m-s)	.003	.042	.017	.016
17	De'_i	Adjusted excess emission rate (g/s-m)	.003	.040	.015	.015
18	Qfc_i	Free-flow emission rate (g/s-m)	.001	.002	.003	.001

17a .003 .042 .017 .016
17b .000 .002 .002 .001
.003 .040 .015 .015

DNJ BLVD ... /
MT VERNON
ALT C

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

PROJECT NO.: ______ ANALYST: ______

SITE: ______ DATE: ______

LINE NO.	SYMBOL	INPUT/UNITS	TRAFFIC STREAM			
		BASIC INPUTS	EB	WB	SB	NB
1	SC	STABILITY CLASS	D	D	D	D
2	U	WIND SPEED ($m\ s^{-1}$)	1.6	1.6	1.6	1.6
3	θ	WIND-ROAD ANGLE (deg)	6°	6°	84°	84°
4	x	LATERAL DISTANCE (m)	75	75	130	100
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	143	66	42	107
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	140	35	0	80
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	5
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.003	.040	.015	.015
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.001	.002	.003	.001
9a		STREET CANYON? YES OR NO	N	N	N	N
		DISPERSION ANALYSIS				
10	χUQ^{-1}	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	240	240	85	90
	Qf	ENTER LINE 9	× .001	× .002	× .003	× .001
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	.24	.48	.255	.009
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷ 1.6
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	0.15	0.3	.16	.056
13	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	5	0	90	95
	Qe	ENTER LINE 8	.003	.040	.015	.015
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	.015	0	1.35	1.425
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷ 1.6
15	χ	CO CONCENTRATION--"MAXIMUM QUEUE"	.009	0	0.84	0.89
16	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	0	0	0	90
	Qe	ENTER LINE 8	× .003	× .040	× .015	× .015
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	0	0	0	1.35
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷ [illegible]
18	χ	CO CONCENTRATION "IMAGINARY QUEUE"	0	0	[illegible]	0.84
19	χ	CO ($mg\ m^{-3}$) TOTAL	0.159	0.3	1.00	0.106
20	χ	CO CONCENTRATION (ppm) TOTAL	0.14	0.26	0.87	0.09
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^{+3})				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

8HR= 1.36 + 1.2 = 2.56

1HR= (1.36 ÷ .7) + 2.2 = 4.14

1990 No-Improvements

INTERSECTION DATA FOR AIR QUALITY ANALYSIS - WORK SHEET

THE MEANING OF THE V/C RESULTS

V/C	IMPLICATIONS
0.70 and below......	No congestion expected
0.80................	Congestion very unlikely
0.90................	Some delays encountered; some congestion during peak events or bad weather
1.00................	Some congestion will be encountered during the peak hour
1.20 and above......	Congestion will extend beyond the peak hour unless traffic travels at other times, involves more transit/shared ride, or trips aren't made (less development; more building vacancies).

NOTES

1. As described in NCHRP bulletin 187
2. L_S = 1450 vph (NCHRP bulletin 187 LOS "E" range)
3. Generally $C_S = L_S \frac{V}{L}$ Cycle length (C_Y) = seconds
4. $G = CY\left(\frac{L}{CMS}\right)$ where CMS is critical movement summary of NCHRP bulletin 187 = sum of critical L's
5. Proportioning cycle time according to largest L (ECMS) for each phase adjusting for minimum greens necessary for pedestrians, etc.
6. $C = \frac{G}{C_Y} C_S$

APPROACH

		(A)	(B)	(C)	(D)	(E)
APPROACH WIDTH	W					
PARKING	P					
LANES	M	2	2	2	2	
PHASE		–	P	Q	–	
HOURLY VOLUME	V	43	604	511	443	
CRITICAL LANE VOLUME (1)	L	24	332	766	729	
LANE CAPACITY/HOUR GREEN (2)	L_S	1450	1450	1450	1450	
APPROACH CAPACITY/HOUR GREEN (3)	C_S	2598	2638	967	881	
DESIGN GREEN (4) (SECONDS)	G	–	31	69	–	
DESIGN GREEN/CYCLE (5)	G/C_Y	.31	.31	.69	.69	
APPROACH CAPACITY	C	805	818	667	608	
VOLUME CAPACITY	V/C	.05	.74	.77	.73	

Project: Harbor Point

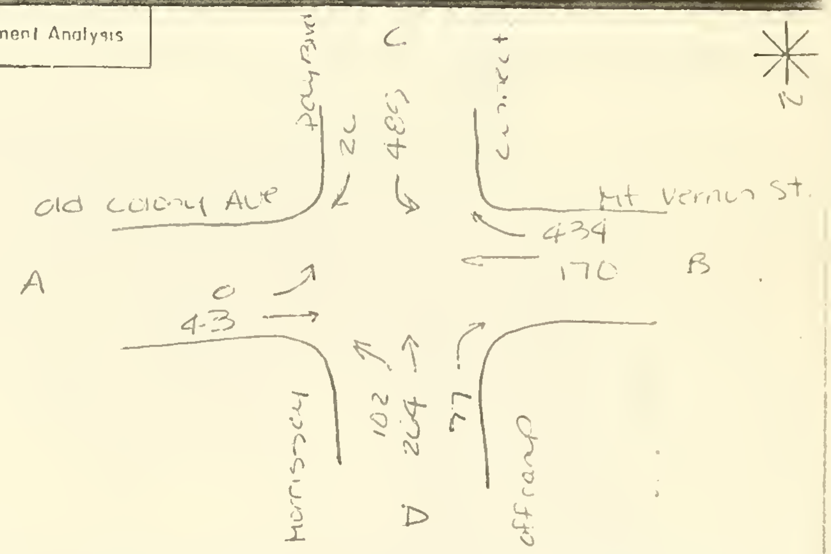
Intersection: Day Blvd. Conn. Mt Vernon Street

SHEET OF SHEETS DATE:

Comp by: MBC Chkd by:

1990 E-Hour

Critical Movement Analysis



Identify Phasing	1	2	3	4

Intersection Level of Service

Direction		Net Approach Volume	Lane Use Factor	Lane Volume
Old Colony	(A)	43	.55	24
Mt. Vernon	(B)	604	.55	332
Day Conn.	(C)	511	.55	281
Morrissey off-ramp	(D)	443	.55	244
	(F)			

	A	B	C	D	E
Net Through Volume	24	332	281	244	
Unprotected Left-Turn	–	–	485	–	
Opposing Left-Turn Volume	–	–	–	485	
TOTAL	24	332	766	729	

Critical Movement Summation CMS

CMS =

CMS =

CMS = Vehicles

APPROACH LANES	LANE-USE FACTOR
1	1.00
2	0.55
3	0.40
4	0.30

INTERSECTION CAPACITY BY LEVEL OF SERVICE

LEVEL OF SERVICE	RANGE OF CAPACITY (VPH) LOW	HIGH
A	0	900
B	901	1,050
C	1,051	1,200
D	1,201	1,350
E	1,351	1,500
F	(Forced flow)	1,500

Mt. Vernon
1990 8-HOUR

WORKSHEET 2--LINE SOURCE EMISSION RATE COMPUTATION
(see instructions following)

Project No.: 403 Analyst: M. Chase

Site: Harbor Point Date: Sept. 1985

Step	Symbol	Input/Units	Traffic Stream			
1	i	Road segment (or approach identification)	EB	WB	SB	NB
2	V_i	Demand volume (vph)	43	604	511	443
3	C_i	Free-flow capacity (vph)				
4	S_i	Cruise speed (mph)	20	30	20	30
5	Ef_i	Free-flow emissions (g/veh-m)	.022	.014	.022	.014
6.1	M_i	Number of lanes in approach i	2	2	2	2
6.2	j	Signalized intersections phase identification	?	?	6	6
6.3	$Cs_{i,j}$	Capacity service volume of approach i for phase j (vph of green)	2598	2638	967	881
6.4	$V_{i,j}$	Demand volume for approach i, phase j (vph)	43	604	511	443
6.5	C_y	Signal cycle length (s)	100			
6.6	$G_{i,j}$	Green phase length for approach i, phase j (s)	31	31	69	69
6.7	C_i	Capacity of approach i (vph)	805	818	667	608
6.8	$P_{i,j}$	Proportion of vehicles that stop	0.70	0.89	0.66	0.62
6.9	$N_{i,j}$	Number of vehicles that stop per signal cycle	0.83	14.9	9.4	7.6
7	N_i	Average number of vehicles in queue at four way stop or two-way stop or end of green phase	0.1	2.8	3.3	2.7
8	Lq_i	Length of vehicle queue for approach i (veh-m/lane)	2	38	28	22
9	Rq_i	Average excess running time on approach (s/veh)	24.6	43.0	28.0	16.0
10	Ea_i	emissions from acceleration (g/veh-m)	.130	.100	.130	.100
11	Ed_i	emissions from deceleration (g/veh-m)	.045	.031	.045	.031
12	Qad_i	emission rate from acceleration and deceleration (g/m-s)	.001	.020	.016	.004
13	Lad_i	Length of acceleration and deceleration (m)	35.8	80.5	35.8	80.5
14	Le_i	Length over which excess emissions apply (m)	40	40	40	40
15	Fs_i	Average idling emission rate (g/s)	.022	.565	.310	.112
16	Qe	Average emission rate (g/m-s)	.001	.054	.022	.011
17	Qe'_i	Adjusted excess emission rate (g/s-m)	.001	.052	.020	.010
18	Qfc_i	Free-flow emission rate (g/s-m)	.001	.002	.003	.002

17a .001 .054 .022 .011
− 17b .000 .002 .002 .001
.001 .052 .020 .010

[illegible]
MT. VER[illegible] 57
1990 - 8 HOUR
NO IMPROVEMENTS

WORKSHEET 5 - INTERSECTION CO DISPERSION ANALYSIS
(see instructions following)

PROJECT NO.: ____________ ANALYST: ____________

SITE: ____________ DATE: ____________

LINE NO.	SYMBOL	INPUT/UNITS	TRAFFIC STREAM			
			EB	WB	SB	NB
		BASIC INPUTS				
1	SC	STABILITY CLASS	D	D	D	D
2	U	WIND SPEED ($m\ s^{-1}$)	1.6	1.6	1.6	1.6
3	θ	WIND-ROAD ANGLE (deg)	60	60	840	840
4	x	LATERAL DISTANCE (m)	75	75	130	100
5	Yu	MAXIMUM LONGITUDINAL DISTANCE (m)	142	73	28	102
6	Yd	MINIMUM LONGITUDINAL DISTANCE (m)	140	35	0	80
7	σ_{z_0}	INITIAL DISPERSION (m)	5	5	5	5
8	Qe	EXCESS EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.001	.052	.020	.010
9	Qf	FREE FLOW EMISSIONS RATE ($g\ m^{-1}\ s^{-1}$)	.001	.002	.003	.002
9a		STREET CANYON? YES OR NO	NO	NO	NO	NO
		DISPERSION ANALYSIS				
10	χUQ^{-1}	NORMALIZED CONCENTRATION ($10^{-3}\ m^{-1}$) FREE FLOW	240	240	85	90
	Qf	ENTER LINE 9	× .001	× .002	× .003	× .002
11	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	.24	.48	.255	0.18
	U	ENTER LINE 2	÷ 1.6	÷ 1.6	÷ 1.6	÷ 1.6
12	χ	CO CONCENTRATION ($mg\ m^{-3}$) THROUGH EMISSIONS	0.15	0.3	.16	0.113
13	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yu)	5	0	25	95
	Qe	ENTER LINE 8	.001	.052	.020	.010
14	χU	NORMALIZED CONCENTRATION ($mg\ m^{-2}\ s^{-1}$)	.005	0	0.5	0.95
	U	ENTER LINE 2	1.6	1.6	÷ 1.6	÷ 1.6
15	χ	CO CONCENTRATION "MAXIMUM QUEUE"	.003	0	0.31	0.594
16	χUQ^{-1}	NORMALIZED CONCENTRATION (FOR Yd)	0	0	0	90
	Qe	ENTER LINE 8	× .001	× .052	× .020	× .010
17	χU	NORMALIZED CONCENTRATION ($mg\ m^{-1}\ s^{-1}$)	0	0	0	0.9
	U	ENTER LINE 2	1.6	1.6	1.6	1.6
18	χ	CO CONCENTRATION "IMAGINARY QUEUE"	0	0	0	0.563
19	χ	CO ($mg\ m^{-3}$) TOTAL	0.153	0.3	0.47	0.144
20	χ	CO CONCENTRATION (ppm)-TOTAL	0.13	0.26	0.41	0.125
		OPTIONAL z CORRECTION (HEIGHTS OTHER THAN 1.8 m ABOVE THE GROUND)				
21	z	HEIGHT OF RECEPTOR (m)				
22		z CORRECTION FACTOR				
23	χ'	CO CONCENTRATION AT HEIGHT z (mg/m^{+3})				
24	χ'	CO CONCENTRATION AT HEIGHT z (ppm)				

8 Hr = 0.925 + 1.2 = 2.125

1 Hr (.925 ÷ .7) + 2.4 = 3.72

APPENDIX M

COOPERATIVE ENERGY DESIGN REVIEW

JUNE 7, 1984

MEMORANDUM

TO: BOSTON REDEVELOPMENT AUTHORITY

FROM: ROBERT J. RYAN, DIRECTOR

SUBJECT: COLUMBIA POINT ENERGY STUDY

Over the past three years the Authority has participated in a number of studies of energy technologies to determine their appropriateness for Boston. More recently, staff at the Authority have begun to focus on several specific potential opportunities for innovative and beneficial technologies. The redevelopment of 1,400 units of housing on 50+ acres at Columbia Point is one such opportunity.

Staff at the Authority, the Boston Housing Authority, and from the redevelopment team have been working with a unique team of experts to shape the attached proposal to identify specific cost-effective energy conservation and supply opportunities which may be implemented during the redevelopment at Columbia Point. The team will be coordinated by staff at Metcalf & Eddy, Inc., a Boston engineering firm with a strong background in district heating and innovative energy systems. Other team members will include Triark-Procedum and Studsvik Energiteknik AB, a joint venture of Swedish engineering and design firms with extensive experience in state-of-the-art energy conservation and supply projects for multi-family buildings, and scientists from the Massachusetts Institute of Technology's Program for Energy Efficient Buildings and Systems and Laboratory of Architecture and Planning. It is doubtful that a more qualified team of experts could be assembled for the purposes at hand.

The Boston Housing Authority has agreed to share the cost of this contract up to Thirteen Thousand ($13,000) Dollars pursuant to the terms of a Memorandum of Understanding, attached hereto.

The Secretary of Massachusetts Executive Office of Energy Resources has expressed strong support for such an effort in the form of an intention to participate in design review and provide such funding as may become available in the future. It is further expected that the results of this effort will place the Authority in a position to apply for between $350,000 and $500,000 in Federal funds to carry this project further.

Therefore, it is recommended that the Authority enter into a contract, substantially the same as the one attached hereto, with Metcalf & Eddy and its consultants to study conservation opportunities and the potential for district heating at Columbia Point for an amount not to exceed Twenty Six Thousand ($26,000) Dollars to be paid out of CDBG funds, one half of

which shall be reimbursed by the Boston Housing Authority and to enter into a Memorandum of Understanding, substantially the same as the one attached hereto, with the Boston Housing Authority regarding said reimbursement.

VOTED: To authorize the Director to enter into a contract, substantially the same as the one attached hereto, with Metcalf & Eddy, Triark-Procedum, Studsvik Energiteknik AB, and the Massachusetts Institute of Technology Joint Program for Energy Efficient Buildings and Systems to study conservation opportunities and the potential for district heating at Columbia Point for an amount not to exceed Twenty Six Thousand ($26,000) Dollars, to be paid out of CDBG funds, one half of which shall be reimbursed by the Boston Housing Authority, and to enter into a Memorandum of Understanding with the Boston Housing Authority, substantially the same as the one attached hereto, regarding said reimbursement.

AGREEMENT

By and Between

BOSTON REDEVELOPMENT AUTHORITY

and

METCALF & EDDY, INC.

This agreement is made this day of , 1984 by and between the Boston Redevelopment Authority, a public body corporate and politic, organized and existing under M.G.L., Chapter 121B, hereinafter referred to as the "Authority" and Metcalf & Eddy, Inc., a corporation organized and existing under the laws of the State of Delaware, with a usual place of business at 50 Staniford Street, Boston, MA, hereinafter referred to as the "Contractor".

WHEREAS, the Authority, together with the Boston Housing Authority, desires to explore options for energy conservation and system at Columbia Point which would not normally be investigated by private redevelopers; and

WHEREAS, the Contractor, together with certain subcontractors hereinafter named, has submitted a proposal to conduct such an investigation, which the Authority finds unique and timely; and

WHEREAS, the Contractor is uniquely qualified to perform such an investigation and the Authority desires to engage the Contractor for said purpose;

NOW, THEREFORE, the Authority and the Contractor for the consideration and under the conditions set forth herein agree as follows:

I. <u>SCOPE OF SERVICES.</u> The Contractor shall perform such services as are outlined in the proposal attached hereto as Exhibit A and shall produce such reports and written products as the Authority shall reasonably require.

II. <u>COMPENSATION.</u> The maximum amount to be paid under this agreement shall be Twenty Six Thousand ($26,000) Dollars. This fee shall coveer all costs incurred by the Contractor herein, including but not limited to salaries, FICA taces, Federal and State unemployment taxes, out-of-pocket costs, including retention of any subcontractors, fringe benefits, supplies and equipment, general cost of doing business, and profit.

III. <u>METHOD OF PAYMENT.</u> For the services performed under Article I, the Authority shall pay Contractor the following lump sum fees for each phase:

Workshops and preliminary analysis	$10,000.00
Final analysis and recommendations	$10,000.00
Final report	$ 6,000.00

IV. TERM OF CONTRACT. The term of this agreement shall be three (3) months from the date first hereinabove written. Time is of the essence to this contract.

V. ASSIGNMENT OF CONTRACT. Except for subcontractual arrangements described in paragraph VI, beleow, the Contractor shall not assign this contract or any rights it may have hereunder to any party without the prior written approval of the Authority.

VI. SUBCONTRACTORS. Contractor shall subcontract with Triark-Procedum, Studsvick Energiteknik AB, and the Massachusetts Institute of Technology's Joint Program for Energy Efficient Buildings and Systems. The Contractor shall designate a person who shall coordinate the efforts of the Contractor and its subcontractors and who shall have complete authority to transmit requests and instructions, receive information, and interpret and define the Contractor's policies and decisions.

VII. OBLIGATIONS OF THE AUTHORITY. The Authority shall:

1) Place at the disposal of the Contractor all available information pertinent to the study upon which the Contractor can rely, including previous reports and any other data relative to design and construction of the proposed redevelopment;

2) Provide access to and make all provisions for the Contractor to enter upon public and private lands as required for the Contractor to perform its work under this Agreement;

3) Designate a person to act as the Authority's representative with respect to the work to be performed under this Agreement, such person to have complete authority to transmit instructions, receive information, and interpret and define the Authority's policies and decisions.

VII. FINAL RELEASE. In consideration of the execution of this Agreement, the Authoirty agrees that simultaneously with the acceptance of what the Authority tenders as the final payment by it under the contract, the Contractor will execute and deliver to the Authority, an instrument under seal releasing and forever discharging the Authority of and from any and all claims, and liabilities whatsoever of every name and nature both at law and in equity, arising from, growing out of, or in any way connected with this contract.

VIII. NON-DISCRIMINATION. Contractor agrees that, in the performance of services under this contract, it will not discriminate against any person because of race, color, creed, sex, or national origin.

IX. <u>AMENDMENTS:</u> This contract may not be changed or amended except in writing by the parties hereto.

APPROVED AS TO FORM:

BOSTON REDEVELOPMENT AUTHORITY

Chief General Counsel

Robert J. Ryan, Director

METCALF & EDDY

Boston Housing Authority, att John Stainton
Boston Redevelopment Authority, att William Whitman
Corcoran, Mullins & Jennison, att Marty Jones
Housing Associates, att Bob Kuehn

Columbia Point - Energy efficient buildings and systems

This is a proposal for a survey and analysis of energy conservation strategies and energy supply options for the redevelopment of Boston's Columbia Point. The project's objective is to present and analyze the cost and benefits of alternative combinations of energy saving steps in the buildings and in the energy supply systems for heating and domestic hot water.

The effort proposed would be a collaborative venture of the MIT Program for Energy Efficient Buildings and Systems and a Swedish team from Triark-Procedum and Studsvik Energiteknik AB. The Swedish team has extensive experience with development of state-of-the-art energy supply projects for multi-family buildings in Sweden. We propose to work closely with the Boston Housing Authroity, the Boston Redevelopment Authority, and the involved developers to insure that our analysis reflects the specific evaluative criteria of those who will develop and manage the project.

Alternative strategies and options will be analyzed against a number of criteria, including capital and operating costs and benefits; performance reliability; maintenance requirements; desirable indoor climate and environment; engineering feasibility; and practicality in terms of the overall projects development schedule.

Strategies and Options to be Reviewed

Our analysis will focus on the three elements of a comprehensive energy program:

- Conservation steps to reduce demand for energy with the new and retrofitted buildings. Among the options to be reviewed are: review of building orientation, structures and floor-plans; added insulation in external walls, the attic, and under the first floor; improved air-tightness in external walls; design of, and new materials for doors and windows; controlled ventilation for heat recovery of exhaust air; etc.
- Heating supply systems in the buildings. Options include radiators with hot water, warm (and cool) air, electricty, heat pump systems, and combination.
- Heating distribution systems. The options of potential use will be dependent on the energy supply need. The less energy needed the more possibilities there are to use alternative and local energy sources as well as the distribution of lower temperatures through the system. Among the alternatives to be considered are the use of large-scale heat pumps to make use of sea water, ground water and sewage.

The product of our work will be recommendation of selected feasible options to create energy and cost efficient heating and cooling. It will also include recommendations for system management and maintenance. We will also suggest approaches which might be used to select a final solution for the energy system at Columbia Point. Our findings will be presented in meetings with the BRA, BHA, and the developers as well as in a written report.

Project Approach

The period for this project will be two to three months. The first major activity of our work will be a carefully planned workshop involving the BHA, BRA, the developers and our entire team. In one or two half-day sessions we will review the present development plans and schedules for Columbia Point's overall development and the present strategies for energy supply and management. We will also review and discuss performance criteria which the developers have for the energy systems. Our team will discuss those plans in light of available knowledge and experience from Sweden and the United States. Together, the group will select a limited number of questions and options to be analyzed during the study period.

Our team will spend the next month exploring and analyzing options. We will do this in collaboration with staff of any of the involved organizations which would like to participate in this aspect of the work.

In the latter part of the second month of our work our team will meet for a second formal meeting with the BHA, BRA and developers. We will present our findings and discuss options for further work. We will be available in the days immediately following this meeting for more detailed discussions with the groups as a whole or with staff of the individual organizations.

Budget

The estimated cost for the project, including the work of the Swedish team, will be $25,000.

For practical administrative reasons we suggest that the contract for this project will be signed by Metcalf & Eddy-FVB District Heating Engineering Inc. FVB-District Heating Engineering Inc. is the American subsidiary of Studsvik Energiteknik AB. MIT and Triark-Procedum will be subcontractors. The involved experts in this project are:

Thomas Bligh, MIT Assistant Professor, Mechanical Engineering
Leon Glicksman, Director, MIT Program for Energy Efficient Buildings and Systems
Hans Gransell, MS, Studsvik/FVB
Michael Joroff, Director, MIT Laboratory of Architecture and Planning
Claes Reuterskiold, MA, Triark-Procedum; MIT Visiting Research Scientist; project leader

Goran Rygert, MA, Triark-Procedum, multi-family energy conservation expert
Richard Tabors, PhD, MIT Energy Laboratory

My colleagues and I are particularly interested in this project. Its scale and strategy for development allows for an approach to energy planning and implementation innovative on the American scene. The combination of an MIT and a Swedish team will allow us to bring to bear state-of-the-art knowledge and implementation.

We look forward to hearing from you. Please do not hesitate to call Claes Reuterskiold should you want more information, (617) 253-1350.

Sincerely,

Claes Reuterskiold for
Birger Abrahamson
President of FVB
for Metcalf & Eddy - FVB District Heating Engineering Inc.
Representing Studsvik Energiteknik AB in the United States

MEMORANDUM OF UNDERSTANDING

By and Between

BOSTON HOUSING AUTHORITY

and

BOSTON REDEVELOPMENT AUTHORITY

Agreement made this day of , 1984 by and between the Boston Housing Authority, a public body corporate and politic duly organized and existing under M.G.L., Chapter 121B, hereinafter referred to as the "BHA" and the Boston Redevelopment Authority, a public body corporate and politic, organized and existing under M.G.L., Chapter 121B, hereinafter referred to as the "BRA".

WHEREAS, the BRA and the BHA are jointly engaged in the redevelopment of Columbia Point and are concerned about the financial stability and operating costs of the project;

WHEREAS, the BRA and the BHA wish to share equally the benefits and costs of a contract between the BRA and Metcalf & Eddy, a Boston engineering firm working in connection with consultants from the Massachusetts Institute of Technology, to study the feasibility and appropriateness of various innovative energy technologies which appear suitable to the Columbia Point project; and

WHEREAS, the amount of said contract, attached hereto and incorporated herein by reference, shall not exceed Twenty Six Thousand ($26,000) Dollars to be paid under the terms and conditions set forth therein;

NOW, THEREFORE, the BRA and the BHA do agree as follows:

1. The BRA agrees that the BHA shall have access to and use of all products and correspondence resulting from work performed by Metcalf & Eddy, under its contract with the BRA.

2. The BRA agrees to notify the BHA in advance of, and to permit representatives of the BHA to participate in, all meetings between itself and Metcalf & Eddy.

3. The BHA and BRA jointly shall agree upon the direction to be given by the BRA to Metcalf & Eddy under its contract with the BRA.

4. The BHA agrees to reimburse the BRA for one-half of all payments made to Metcalf & Eddy, upon submission to BHA of the invoices submitted to BRA by Metcalf & Eddy, in accordance with the contract between BRA and Metcalf & Eddy, attached hereto and incorporated herein. Reimbursement shall be made by BHA within 30 days.

5. Under terms of this agreement, the maximum sum to be reimbursed or paid by the BHA to the BRA for the Metcalf & Eddy contract shall be Thirteen Thousand Dollars ($13,000).

6. Neither this memorandum nor the said contract may be changed except with the written approval of the parties hereto.

APPROVED AS TO FORM:

BOSTON REDEVELOPMENT AUTHORITY

Chief General Counsel	Robert J. Ryan, Director

BOSTON HOUSING AUTHORITY

Chief General Counsel	Lewis H. Spence, Receiver/Administrator

APPENDIX N

COLUMBIA POINT

ENERGY STUDY RESULTS

MEMORANDUM

TO: MARTHA BAILEY

FROM: DAVID CORRSIN

DATE:

SUBJECT: COLUMBIA POINT ENERGY STUDY RESULTS

I have completed my analysis of the energy situation on Columbia Point. I was assisted in this effort by Dwayne S. Breger, Consultant to Argonne National Laboratory and the International Energy Agency and co-author of "A Seasonal Storage Solar Energy Heating System for the Charlestown, Boston Navy Yard National Historical Park, Phase II Analysis with Heat Pump", published by Argonne National Laboratory. It appears that servicing the redeveloped housing project with an energy plant centered around a cogeneration unit is, in fact, the most economic option. We should remember that this study is only of the "first cut" variety and that there is some inherent approximateness. But we are certainly in the right ballpark.

Moreover, I have had conversations with many potential developers for the energy system which have confirmed this study. In general, the developers feel they can save the designated real estate developer money in a situation like this and turn a profit for themselves.

In the rest of this memo I will summarize the process I have gone through and the more important discoveries I made. The technical and financial analyses are detailed in the appendix. The financial analysis is also summarized just before the appendix.

Energy Loads of Facilities on Columbia Point

Essentially, only the redeveloped housing project and the buildings yet to be constructed by BALP could be compatible with a Point-wide energy system. The problem with the UMass Harbor Campus, the John F. Kennedy Library, and the new State Archives building is that all are all-electric. Most simply stated, they heat their buildings with coils that are akin to those of an electric stove or a toaster throughout the air distribution ducts. Any Point-wide energy system would have to produce heat at one central plant and transport it in the form of piped hot water. To make the all-electric buildings compatible, each would have to install a considerable amount of new plumbing. That would be prohibitively expensive.

The housing project redevelopment and the unbuilt Bayside buildings are potentially compatible because they have yet to be completely designed -- and so can be changed to use hot water. I left the Bayside buildings out of this study because the timing of their construction was unclear and concentrated on the redeveloped housing project. However, if we get to the point of negotiating with an energy developer we should encourage and help them approach Bayside.

Redevelopment Housing Project

Because a developer had not been designated, because both CA and CMJ's designs seemed far from final, and because the designers had not yet seriously considered the energy aspect of their designs, I created a simulation as a

surrogate for both developments to use in this study. The square footage and number of units in the surrogate are compared to those of the CA and CMJ proposals in Table 1.

Table 1

	Net Total Sq. Ft.	# Units	Av. Sq. Ft. /Unit
CMJ	1,161,755	1,200	968
CA	1,570,700	1,587	989
Simulation	1,300,000	1,333	975

The process I went through to develop a profile of the development's energy consumption is contained in the first part of the appendix. Most grossly, I took generally used factors which predict by end-use (heat, hot water, air conditioning) the amount and temporal distribution of energy use a particular type of building is likely to have, on a per square foot basis, adjusted them to our situation, and applied them to the simulated development. As a check, I was able to compare the prediction for annual air conditioning use to historical data collected by CMJ and the two differed only approximately by 5%.

Once the development's loads were established, I assumed four different systems for servicing them:

Conventional

(1) a conventional system of gas boilers, electric hot water heaters, and electric chillers in the basement of each building.

Existing Boilers

(2) the boilers now in place at Columbia Point, which are of high quality and efficiency and reportedly in excellent condition, are reused. They provide heat for space heat and hot water and cool water for air conditioning to the entire development through hot water piped underground in a new piping system. Several other new components are necessary.

Existing Boilers With Ice Storage

(3) Same as system #2 except for cooling. Chilled water for air conditioning is provided by an innovative central ice storage system. Ice is formed from water in winter, insulated and used in summer to generate chilled water to provide air conditioning.

Cogenerating

(4) A cogeneration unit, in conjunction with an absorption chiller, provide heat, hot water, air conditioning and electricity to the development. Existing boilers are kept for back-up. Excess electricity is sold to Boston Edison Company.

The costs for these systems were determined by either contacting actual manufacturers or from the literature. In the Conventional case, cost data for heat and hot water systems were obtained from CMJ. However, data from CMJ on gas boilers generated a heating system cost which seemed quite large.

This led me to believe CMJ's information was either incorrect or included related costs (e.g., plumbing, baseboards, etc.) which they thought had been separated out. As a consequence, I created a fifth scenario in which the capital costs of the heating system is equal to that of the existing boiler scenario (#2), a more reasonable figure.

Financial Analysis

In comparing the lifecycle costs of the five scenarios the following conditions were assumed:

interest rate (a): 10%

inflation rate (i) 5%

fuel price escalation rate (f): 8.5% (inflation + 3.5%)

system financial life: 25 years

electric rate escalation rate (e): 8.5% (inflation + 3.5%)

The cost streams resulting from servicing the energy needs of the redeveloped housing project were generated and their total present worth calculated. These are summarized in Table 2 and documented more fully in the appendix.

Ranked from least to greatest cost the scenarios are:

(1) Cogeneration

(2) Existing Boilers With Ice Storage

(3) Existing Boilers

(4) Modified Conventional

(5) Conventional

cc: Bill Whitman

PL5/H/103183

Table 2

(Thousands of dollars)

Scenario

	Conventional	Modified Conventional	Use Existing Boilers	Existing Boilers w/ Ice Storage	Cogeneration
Capital Cost	7,090	2,685	2,685	3,079	3,800
Yearly Capital Payment	781	296	296	339	419
1st Year Fuel Cost	362	362	779	483	762
1st Year Misc.	85	85	85	175	197
1st Year Electric Cost	1,346	1,346	760	914	454
1st Year Electric Revenue					20
1st Year Net Annual Cost	2,574	2,089	1,920	1,911	1,812
Present Value of Lifecycle Costs (1983$)	41,332	36,926	33,670	32,557	29,711
Savings vs. Modified Conventional (1983$)			3,256	4,369	7,215

Rate of Return (U.S. M. Conventional)

Payback period (vs. M. Conventional)

PL5/I/102683

Appendix

Columbia Point

Loads	Annual
Space Heat	30.0×10^3 Btu/ft^2/yr
Hot Water	14.0×10^3 Btu/ft^2/yr
Cooling	17.5×10^3 Btu/ft^2/yr
Electric CoP = 2.5	2.1 Kwh/ft^2
Absorption CoP = 1.4	12.5×10^3 Btu/ft^2/yr
Light & Power	8.0 Kwh/ft^2

Total Annual @ 1.3×10^6 ft.^{2}

Space Heat	39.0×10^9 Btu/yr
Hot Water	18.2×10^9 Btu/yr
Cooling	22.8×10^9 Btu/yr
Electric CoP = 2.5	2.7 Gwh/yr
Absorption CoP = 1.4	16.3×10^9 Btu/yr
Light & Power	10.4 Gwh/yr

Columbia Point

Thermal Loads — Monthly

	DWH	Space Heat		Total Without Cooling	Cooling		Total With Cooling
	$\times 10^9$ Btu	DD	$\times 10^9$ Btu	$\times 10^9$ Btu	DD	$\times 10^9$ Btu	$\times 10^9$ Btu
Jan.	1.52	1,110	7.70	9.22			9.22
Feb.	1.52	969	6.72	8.24			8.24
Mar.	1.52	834	5.79	7.31			7.31
Apr.	1.52	492	3.41	4.93			4.93
May	1.52	218	1.51	3.03	20	0.50	3.53
Jun.	1.52	27	0.19	1.71	117	2.89	4.60
Jul.	1.52			1.52	260	6.41	7.93
Aug.	1.52	6	0.05	1.57	203	5.01	6.58
Sep.	1.52	76	0.53	2.05	61	1.50	3.55
Oct.	1.52	301	2.09	3.61			3.61
Nov.	1.52	594	4.12	5.64			5.64
Dec.	1.52	992	6.88	8.40			8.40
Total	18.2	5,621	39.0	57.2	661	16.3	73.5

Columbia Point

Electrical Loads		Monthly

	Light & Power	Cooling if Electric		TOTAL if Electric Cooling
	Mwh	DD	Mwh	Mwh
Jan.	867			867
Feb.	867			867
Mar.	867			867
Apr.	867			867
May	867	20	82	949
Jun.	867	117	478	1,345
Jul.	867	260	1,062	1,929
Aug.	867	203	829	1,696
Sep.	867	61	249	1,116
Oct.	867			867
Nov.	867			867
Dec.	867			867
Total	10,400	661	2,700	13,100

Columbia Point

Thermal Load - Average Daily Peak

Assumption (MITRE p.295)

Peak-Day Factors

2.25 × daily average (Summer)
1.50 × daily average (Winter)

	Winter or Summer	Hrs/ Month	Total Monthly Load $\times 10^9$ Btu With Thermal Cooling	Without Cooling		Average Hourly Load $\times 10^6$ Btu/Hr	Average Daily Peak $\times 10^6$ Btu/Hr	Peak Daily Peak* $\times 10^6$ Btu/Hr
Jan.	W	744	9.22	9.22	12.4	12.4	18.6	24.8
Feb.	W	672	8.24	8.24	12.3	12.3	18.4	24.5
Mar.	W	744	7.31	7.31	9.8	9.8	14.7	19.6
Apr.	W	720	4.93	4.93	6.8	6.8	10.3	13.7
May	S	744	3.53	3.03	4.1	4.7	10.7	14.3
Jun.	S	720	4.60	1.71	2.4	6.4	14.4	19.2
Jul.	S	744	7.93	1.52	2.0	10.7	24.0	32.0
Aug.	S	744	6.58	1.57	2.1	8.8	19.9	26.5
Sep.	S	720	3.55	2.05	2.8	4.9	11.1	14.8
Oct.	W	744	3.61	3.61	4.9	4.9	7.3	9.7
Nov.	W	720	5.64	5.64	7.8	7.8	11.8	15.7
Dec.	W	744	8.40	8.40	11.3	11.3	16.9	22.5

* Peak Daily = Design Peak Load to determine system capacity requirements. Calculated as 1 1/3 times Average Daily Peak.

Design Conditions Heating (January) 24.8×10^6 Btu/hr.
Cooling (July) 32.0×10^6 Btu/hr.

PL5/1/102683

Distribution System

Design — 4 pipe system
steel, insulated pipes

Sizing

See following pages

Cost

Main — 5,127 ft. (1,563 m)

Hot water	135 mm @ $350/m = $547,050
Chilled water	250 mm @ $550/m = $859,650

Secondary - 2,500 ft. (762m)

Hot water	70 mm @ $200/m = $152,400
Chilled water	100 mm @ $225/m = $171,450

* Prices from IEA report (includes installation, valves, expansion loops, etc.)

Total (Pipeline) $1,730,550

Pumps — Hot water = $50,000
Chilled water = $50,000

Total $1,830,550

Columbia Point

Distribution Sizing

Hot Water

Q peak = 24.8×10^6 Btu/hr

Assume Delta T = 220 °F - 145° = 75°F at peak

CP (water) = 1 Btu/lb °F
P (water) = 62.4 lb/ft^3

Q = in cp Delta T

$$M = \frac{Q}{CpDelta\ t} = \frac{24.8 \times 10^6 \text{ Btu/hr}}{1 \frac{\text{Btu}}{\text{lb}^\circ\text{F}} \times 75\ ^\circ\text{F}} = 3.31 \times 10^5 \text{ lb/hr}$$

Volumetric flow = $5{,}300\ ft^3/hr$: $0.042\ m^3/sec$
(main distribution) $88.3\ ft^3/min$
$1.47\ ft^3/sec$
11.0 gal/sec

Pipe Size

Vol = 0.042 = (velocity)

Water Velocity	Pipe diam	diam = $2 \frac{(.042)^2}{(vel)}$ per second
1.0 m/s	231 mm	
1.5	189	
2.0	164	
2.2	156	rear optimum (IEA réport, p. 73)

156mm = 6.15 inches

Columbia Point

Distribution Sizing

Chilled Water

Q peak

$Q\ tot = 22.8 \times 10^9$ Btu/yr

$Q\ (July) = 9.0 \times 10^9$ Btu

Average Hourly (July) = 12.1×10^6 Btu/hr

Average Daily Peak Peak (July) = 27.1×10^6 Btu/hr

Q peak = Peak Daily Peak (July) = 36.2×10^6 Btu/hr

Assume Delta T = 30 °F = 62 - 32 °F

$$M = \frac{Q}{Cp\,Delta\ T} = \frac{36.2 \times 106\ Btu/hr}{\frac{Btu}{1lb°F}\quad 30\ °F} = 12.07 \times 10^5\ lb/hr$$

Volumetric Flow = (main distribution

$18{,}854\ ft^3/hr$ $0.148\ m^{3/sec}$

$314\ ft^3/min$

$5.24\ ft^3/sec$

Pipe Size

0.148 = (velocity)

$$diam = 2\ \frac{(.148)}{(vel)}\ 1/2$$

Water velocity	Pipe diam
2.5	275 mm
2.6	269 mm
2.55	272 mm

272 mm = 10.72 inches

CB Boilers - presently in place at Columbia Point

4 boilers
350 HP
15 psig steam, design: set up for 7-10 psig

Operate at 10×10^6 Btu/hr up to 12×10^6 Btu/hr

Fuel - #6 oil - can switch to #2 oil, #5 oil, gas

Fuel Efficiency = .87

Heat Exchangers steam hot water

$20,000 (to handle all four existing boilers)

Cogenerator

Design - Industrial internal combustion engine able to run on various fuels - diesel, gas, oil.

System can be designed with smaller engines in series to allow for phased development and less total down time for maintenance.

Sizing - Electric Load

Yearly average power 1.2 Mw (1,200 Kw)

Cogenerator is sized for base load to provide a high utilization factor.

600 K Cogenerator, electric output

Cost - \$1,200/Kwe x 600 Kw = \$720,000

Heat Output - $6{,}000 \frac{\text{Btu hr}}{\text{KW}} \times 600 \text{ K} = 3.6 \times 10^6$ Btu/hr

Fuel Input - $3.6 \times 10^6 \frac{\text{Btu}}{\text{hr}} \frac{(1)}{.6} = 6.0 \times 10^6$ Btu/hr

Annual @ Utilization factor $f_u = .80$

Annual fuel = $6.0 \times 10^6 \frac{\text{Btu}}{\text{hr}} (.80) (8{,}760 \frac{\text{hr}}{\text{yr}}) = 42.0 \times 10^9$ Btu

Annual heat output = $3.6 \times 10^6 \frac{\text{Btu}}{\text{hr}} (.80) (8{,}760) = 25.2 \times 10^9$ Btu

Annual electric output = 600 Kw (.80) (8,760) = 4.2 Gwh

Short-Term Thermal Storage

Design Parameters

$$C_L \text{ (water)} = 1 \frac{\text{Btu}}{\text{lb°F}} \times 62.4 \frac{1\text{lb}}{\text{ft}^3} = 62.4 \text{ Btu/ft}^3 \text{ °F}$$

Winter heat storage — Delta T = 210 °F - 160 °F = 50°F
C_L = (62.4) (50) = 3,120 Btu/ft^3

Summer chilled storage — Delta T = 62.°F - 32°F = 30°F
C_L = (62.4) (30) = 1,872 Btu/ft^3

Peak Capacity Considerations

Capacity of heating is large due to existence of four boilers. Storage will limit the frequency that a second boiler will be needed.

Cooling capacity is constrained by capacity of absorption chiller plus storage. May need back-up chiller (electric or absorption).

Sizing of Storage Facility (storage M = 0.80)

Heat - Meet average daily peak demand (above one boiler) for 5 hrs.

$$10\times10 \frac{\text{Btu}}{\text{hr}} \times 5 \text{ hrs} \times \frac{1}{.80} = 62.5 \times 10^6 \text{ Btu}$$

$$\text{Volume} = \frac{62.5 \times 106 \text{ Btu}}{3,120 \text{ Btu/ft}^3} = 20,000 \text{ ft}^3; \text{ (150,000 gal); (567m}^3\text{)}$$

Chilled water meet average daily peak (above chiller at 12×10^6 Btu/hr) for 5 hrs (1,000 tons)

$$15 \times 10^6 \frac{\text{Btu}}{\text{hr}} \times 5 \text{ hrs} \times \frac{1}{80} = 93.8 \text{ Btu}$$

$$\text{Volume} = \frac{93.8 \times 10^6 \text{ Btu}}{} = 50,000 \text{ ft}^3; \text{ (375,000 gal); (1,418m}^3\text{)}$$

Cost

	120,000 gas	300,000 gal
Tank	\$80,000	\$110,000
Foundation	7,000	10,000
Point & Insulation @ \$5/ft^2	11,000	20,100
Total	\$98,300	\$140,000

Columbia Point

Winter Ice Storage

Cooling Load 22.8×10^9 Btu/yr

Amount of ice required (assume M = .85)

$Q = 22.8 \times 10^9 \left(\frac{1}{.85}\right) = 26.8 \times 10^9$ Btu

$C_p = 1$ Btu/lbm°F - @ Delta T = 47-32 = 15°F $C_p = 15$ Btu/lb
heat of fusion = 144 Btu/lb
total "heat" stored = 144 + 15 = 159 Btu/lb

Mass ice = $\frac{26.8 \times 109 \text{ Btu}}{159 \text{ Btu/lb}} = 1.69 \times 10^8$ lb

Volume ice = $\frac{1.69 \times 108 \text{ lb}}{57.2 \text{ lb/ft}^3} = 2.95 \times 10^6 \text{ ft}^3$ ($8.35 \times 10^4 m^3$)

Volume equiv. to cube, 143 ft/side

or pile 25 ft height, and 344 ft/side

Design

Chillers

Absorption Chiller

Size Supply 12×10^6 Btu/hr of cooling power
1 ton = 12,000 Btu/hr
chillers = 1,000 tons

Chiller 1,000 tons - $190,000
to use with CB boiler output

Chiller/Heater (Hitachi)

to use with co-generator exhaust 3.6×10^6 Btu/hr
300 ton capacity $120,000

Electric Chiller	1,000 tons	$150,000
	500 tons	$ 80,000

Ice Pond

Cost

Excavation	$2.25/m^3$	1.225×10^6 ft^3 35,000 m^3	$ 78,000
Liner	$5.25/m^2$	143,500 ft^2 13,336 m^2	$ 70,000
Blanket	$10.00/m^2$	143,500 ft^2 13,336 m^2	$133,000
Pumps, piping control			$ 80,000
Snow machines	$10,000/machine	6 machines	$ 60,000
Land	$5/m^2$	160,000 ft^2 15,000 m^2	$ 74,000

Total $495,000

Scenario O

Conventional Base Case*

Capital Cost	
	$2,685,000
1st Year Fuel Cost - escalation rate = 8.5%	
	$ 361,500/yr
1st Year Misc. - escalation rate = 5%	$ 85,000/yr
1st Year Cost - escalation rate = 8.5%	$1,345,500/yr

* Disregard CMJ cost data and assume capital cost as in Scenario 1 for comparison.

Scenario O

Decentralized (Individual Building Units)

Gas Boiler
Electric Hot Water
Electric Air Conditioning (Central Chiller, Each Building)

Heating - Sizing

Scale-up method applicable since CMJ uses modular boilers. Just add more as project size increases.

CMJ Examples:

10 unit building - 5 one bd. @ 650 ft^2 = 7,000 ft^2 and (700 ft^2/unit)
5 two bd. @ 750 ft^2

Gas Furnace: 756,000 Btu
(756,000 Btu)(7,000 ft^2) = 108 Btu/ft^2

12 Units: Guess 6 one bd.
6 two bd. = 8,400ft^2 and (700 ft^2/unit)

Furnace: 800,000 Btu
(800,000 Btu)/(8,400ft^2) = 95 Btu/ft^2

6 Units: Guess 3 one bd.
3 two bd. = 42,000ft^2 and (700 ft^2/unit)

Furnace: 420,000 Btu

(420,000 Btu)/(4,200 ft^2) = 100 Btu/ft^2

12 Units: Guess 6 one bd.
6 two bd. = 8,400 ft^2 and (700 ft^2/unit)

Furnace: 950,000 Btu

(950,000 Btu)/(8,400 ft^2) = 113 Btu/ft^2

Assume: 110 Btu/ft^2 capacity

Cost

104 units (size unknown)
(104 units) (700 sq.ft./unit)(110 Btu/ft^2)
or (\$375 × 10^3)/(104 units)(700 ft^2/unit) = 8,008,000 Btu capacity

(\$375 × 10^3)/(8.008 × 10^6 Btu) = \$46.8/10^3 Btu
(\$375 × 10^3)/(72.800 × 10^3 ft^2) = \$5.15/ft^2 capital cost

Scenario O

Conventional Base Case

Hot Water

Cost $100/unit.* Total capital cost installed assume typical unit is 700 ft^2.

Cost/Ft^2

($100 unit)/(700 ft^2/unit) = $0.14/$ft^2$

Air Conditioning

Avg. daily peak = 12,000 $\times 10^6$ Btu/hr for 5 hrs.
Peak daily peak = (1.333)(12 $\times 10^6$ Btu/hr = 16 $\times 10^6$ Btu/hr (1,333 tons)

Assume chiller costs scale up or down linearly with capacity (i.e., the cost of many individual building-size chillers will be the same as that of one large central chiller.

TRANE: Boston, MA - Electric Chiller: 500 tons - $80,000
($80,000)/500 tons) = $160/ton

(1,333 tons) ($160/ton = $213,280

* From Alan Isbitz, CMJ

Scenario O

Conventional Base Case

Electric Requirements

Air Conditioning

Method 1 - 1,333 ton capacity*

(1,333 tons)(12,000 Btu/hr/ton) = 16.0×10^6 Btu/hr System Capacity

CMJ finds air conditioning runs 1,500 hrs/yr

(16.0×10^6 Btu/yr) (1,500 hrs/yr = 24.0×10^9 Btu/yr output
Assume CoP of 2.5

(24.0×10^9 Btu)/yr)/(2.5) = 9.6×10^9 Btu/input

(9.6×10^9 Btu)/(3,414 Btu/Kwh) = 2.8×10^6 Kwh/yr

Air Conditioning

Method 2 - Uses load infor common to all other Scenarios.

$\frac{\text{Cooling Demand}}{\text{CoP } 2.5}$: 22.8×10^9 Btu/yr = 2.7 Gwh/yr

Hot Water

Hot water demand: 18.2×10^9 Btu/yr - common to all Scenarios

Elec Resistance CoP = 1

(18.2×10^9 Btu/yr)/(3.414×10^3 Btu/Kwh) = 5.3×10^6 Kwh/yr

* 1 ton = 12,000 Btu/hr

Scenario O

Capital Cost

Boilers (1.3×10^6 ft^2) ($5.15/$ft^2$) =	$6,695,000
Hot water heaters (1.3×10^6 ft^2) ($0.14/$ft^2$) =	$ 182,000
Electric Chillers ($160/ton) (1,333 tons) =	$ 213,000
	$7,090,000 Total

Note: Contingency not included because boiler cost seems quite high and must include all costs classified under contingency in other scenarios.

Fuel Requirements and Cost (Annual)

Boilers

(39.0×10^9 Btu/yr)/(.8) = 48.9×10^9 Btu/yr natural gas

(48.9×10^9 Btu/hr)/(1.014×10^3 Btu/ft^3) =

Volume = 48.2×10^6 ft^3/yr natural gas use

(48.2×10^3 ft^3/yr) ($7.50/ ft^3) =

Cost = $361,500/yr — $361,500/yr

1st Year Misc. (10% of capital cost)

$709,000 - seems much too high
try same as Scenario 1 — $ 85,000/yr

1st Year Electric Cost

Light and power: (same as Scenario 1) = $760,000/yr
Air Conditioning: (2.7×10^6 Kwh/yr) ($.07309/Kwh = $197,500/yr
Hot Water: (5.3×10^6 Kwh/yr ($.07309/Kwh = $387,500/yr

$1,345,500/yr

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Scenario O

(Conventional w/CMJ Cost Assumptions) (Base Case)

Year	Capital Payment (= 10% ($x10^3)	Fuel Cost (=8.5% ($x10^3)	Misc. (i =5% ($x10^3)	Elec. Cost (=8.5% ($x10^3)	Net Annual Cost ($x10^3)	Present Worth Factor (=10%)	Total Present Worth of Cost ($x10^3)
1984	781	362	85	1,346	2,574	.9091	2,340
1985	781	393	89	1,460	2,723	.8264	2,250
1986	781	426	94	1,584	2,885	.7513	2,168
1987	781	462	98	1,719	3,060	.6830	2,090
1988	781	502	103	1,865	3,251	.6209	2,019
1989	781	544	108	2,023	3,456	.5645	1,951
1990	781	591	114	2,195	3,681	.5132	1,889
1991	781	641	120	2,382	3,924	.4665	1,831
1992	781	695	126	2,584	4,186	.4241	1,775
1993	781	754	132	2,804	4,471	.3855	1,724
1994	781	818	138	3,042	4,779	.3505	1,675
1995	781	888	145	3,301	5,115	.3186	1,630
1996	781	964	153	3,581	5,479	.2897	1,587
1997	781	1,045	160	3,886	5,574	.2633	1,547
1998	781	1,134	168	4,216	6,299	.2394	1,508
1999	781	1,231	177	4,574	6,763	.2176	1,472
2000	781	1,335	186	4,963	7,265	.1978	1,437
2001	781	1,449	195	5,385	7,810	.1799	1,405
2002	781	1,572	205	5,843	8,401	.1635	1,374
2003	781	1,706	215	6,339	9,041	.1486	1,343
2004	781	1,851	226	6,878	9,736	.1351	1,315
2005	781	2,008	237	7,463	10,489	.1228	1,288
2006	781	2,179	249	8,097	11,306	.1117	1,263
2007	781	2,364	261	8,786	12,192	.1015	1,237
2008	781	2,565	274	9,532	13,152	.0923	1,214
			Present Worth of Lifecycle Costs				$41,332,000

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Scenario O

(Conventional w/BRA Cost Assumptions) (Modified Base Case)

Year	($x10^3) Capital Payment	($x10^3) Fuel Cost	($x10^3) Misc.	($x10^3) Elec. Cost	($x10^3) Net Annual Cost	(=10%) Present Worth Factor	($x10^3) Total Present Worth of Cost
1984	296	362	85	1,346	2,089	.9091	1,899
1985	296	393	89	1,460	2,238	.8264	1,849
1986	296	426	94	1,584	2,400	.7513	1,803
1987	296	462	98	1,719	2,575	.6830	1,759
1988	296	502	103	1,865	2,766	.6209	1,717
1989	296	544	108	2,023	2,971	.5645	1,677
1990	296	591	114	2,195	3,196	.5132	1,640
1991	296	641	120	2,382	3,439	.4665	1,604
1992	296	695	126	2,584	3,701	.4241	1,570
1993	296	754	132	2,804	3,986	.3855	1,537
1994	296	818	138	3,042	4,294	.3505	1,505
1995	296	888	145	3,301	4,630	.3186	1,475
1996	296	964	153	3,581	4,994	.2897	1,447
1997	296	1,045	160	3,886	5,387	.2633	1,418
1998	296	1,134	168	4,216	5,814	.2394	1,392
1999	296	1,231	177	4,574	6,278	.2176	1,366
2000	296	1,335	186	4,963	6,780	.1978	1,341
2001	296	1,449	195	5,385	7,325	.1799	1,318
2002	296	1,572	205	5,843	7,916	.1635	1,294
2003	296	1,706	215	6,339	8,556	.1486	1,271
2004	296	1,851	226	6,878	9,251	.1351	1,250
2005	296	2,008	237	7,463	10,004	.1228	1,228
2006	296	2,179	249	8,097	10,821	.1117	1,209
2007	296	2,364	261	8,786	11,707	.1015	1,188
2008	296	2,565	274	9,532	12,667	.0923	1,169
			Present Worth of Lifecycle Costs				$36,926,000

Scenario 1

CB Boilers and Absorption Chiller

Cost

Central Plant

Boilers (relocate, start-up)	$ 30,000
Heat Exchangers (for 4 boilers)	20,000
Absorption Chiller (base) 1,000 tons	190,000
Absorption Chiller (back-up) 1,000 tons	190,000
Thermal Storage - 375,000 gal	140,000
Subtotal	$ 570,000
Contingency (rest of system, delivery, set-up) 50%	$ 285,000
Total	$ 855,000
Distribution	$1,830,000
Total	$2,685,000

Fuel Requirements (annual)

Boiler #1

Output 10×10^6 Btu/hr meet base load and charge store utilization factor (downtime, reduced output) $f_u = 0.80$ fuel efficiency = .87;
Heat Output = 53.0×10^9 Btu

Fuel $(10 \times 10^6 \text{ Btu/hr})(.80)(\frac{1}{.87})(8{,}760 \frac{\text{hr}}{\text{yr}}) = 80.6 \times 10^9$ Btu

Boiler #2 and #3

Heat Output = (Total Load) (distribution efficiency) - Boiler #1
$= (73.5 \times 10^9 \text{ Btu}) \frac{1}{85} - 53.0 \times 10^9 \text{ Btu} = 33.5 \times 10^9$ Btu

Fuel M = .87 operate at $10 \times 10^6 \frac{\text{Btu}}{\text{hr}}$ and charge storage with excess

$= 33.5 \times 10^9 \text{ Btu } \frac{(1)}{.87} = 38.5 \times 10^9$ Btu

Total Thermal 119.1×10^9 Btu

Electrical 10.4×10^6 Kwh

Scenario 1

CB Boilers & Absorbtion Chiller With Short-Term Thermal Storage

Capital Cost

Energy Production	$ 855,000
Distribution	1,830,000
	$2,685,000

1st Year Fuel Cost

$(119.1 \times 10^9$ Btu/yr) / (134×10^3 Btu/gal #6 oil, .5%S) = 888,806 gal/yr

(888,806 gal) ($.876/gal) = $778,594 /yr

1st Year Misc.

Misc. (Cleaning, routine maintenance, etc., for pumps, taxes, insurance (10% of Central Plant Cost) = $85,000/yr

1st Year Electric Cost

(Must buy from Edison for tenants' light & power) (at K rate: master-metered)

8.67×10^5 Kwh/month
10.4×10^6 Kwh/yr
each month = (120 Kwh)(rate for first 120 Kwh @ $.0698/Kwh) +
(867,000 Kwh-120 Kwh)($.03309/Kwh) + (867,000Kwh) (fuel adj. @ $.014/Kwh) =
$8.38 + $28,685 + $34,680 = $63,373/mo or $760,476/yr

Scenario 1

CB Boilers & Absorbtion Chiller With/Short-Term Thermal Storage

Year	Capital Payment	Fuel Cost	Misc.	Elec. Cost	Total Annual Cost	Present Worth Factor	Total Present Worth of Cost
1984	$295,806	$ 778,594	85,500	760,476	1,920,376	.9091	1,745,814
1985	295,806	844,775	89,775	825,116	2,055,472	.8264	1,698,642
1986	295,806	916,580	94,264	895,251	2,201,901	.7513	1,654,288
1987	295,806	994,490	98,977	971,348	2,360,621	.6830	1,612,304
1988	295,806	1,079,021	103,926	1,053,912	2,532,665	.6209	1,572,532
1989	295,806	1,170,738	109,122	1,143,495	2,719,161	.5645	1,534,966
1990	295,806	1,270,251	114,578	1,240,692	2,921,327	.5132	1,499,225
1991	295,806	1,378,222	120,307	1,346,150	3,140,485	.4665	1,465,036
1992	295,806	1,495,371	126,322	1,460,573	3,378,072	.4241	1,432,640
1993	295,806	1,622,477	132,638	1,584,722	3,635,643	.3855	1,401,540
1994	295,806	1,760,388	139,270	1,719,423	3,914,877	.3505	1,372,164
1995	295,806	1,910,021	146,234	1,865,574	4,217,635	.3186	1,343,739
1996	295,806	2,072,372	153,546	2,024,148	4,545,872	.2897	1,316,939
1997	295,806	2,248,524	161,223	2,196,200	4,901,753	.2633	1,290,632
1998	295,806	2,439,649	169,284	2,382,877	5,287,616	.2394	1,265,855
1999	295,806	2,647,019	177,748	2,585,422	5,705,995	.2176	1,241,625
2000	295,806	2,872,015	186,636	2,805,183	6,159,640	.1978	1,218,377
2001	295,806	3,116,136	195,967	3,043,623	6,651,532	.1799	1,196,611
2002	295,806	3,381,008	205,766	3,302,331	7,184,911	.1635	1,174,733
2003	295,806	3,668,393	216,054	3,583,029	7,763,282	.1486	1,536,624
2004	295,806	3,980,207	226,857	3,887,586	8,390,456	.1351	1,133,551
2005	295,806	4,318,524	238,200	4,218,031	9,070,561	.1228	1,113,865
2006	295,806	4,685,599	250,110	4,576,564	9,808,079	.1117	1,095,562
2007	295,806	5,083,875	262,615	4,965,572	10,607,868	.1015	1,076,699
2008	295,806	5,516,004	275,746	5,387,645	11,475,201	.0923	1,059,161

Total Present Worth of Lifecycle Costs $33,670,124

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Scenario 2

CB Boilers and Winter Ice Storage

Cost

Central Plant

Boilers (relocate, start-up)	$ 30,000	
Heat Exchanges (for 3 boilers)	20,000	
Thermal Storage - 150,000 gal	98,000	
Winter Ice Store	495,000	
Absorption Chiller (back-up) 1,000 tons	190,000	
Subtotal		$ 833,000
Contingency - 50%	$ 416,000	
Total		$1,249,000
Distribution	$1,830,000	
Total		$3,079,000

Fuel Requirements (annual)

Boiler #1			
	output	10×10^6 Btu	5×10^6 Btu
	F_u	0.60	0.20
	M	0.87	0.80

Heat Output $= (10 \times 10^6 \frac{\text{Btu}}{\text{hr}})(0.60)(8,760 \frac{\text{hr}}{\text{yr}}) + (5 \times 10^6)(.20)(8,760) = 61.3 \times 10^9$ Btu

Fuel $(10 \times 10^6)(.60)(8,760)(\frac{1}{.87}) + (5 \times 10^6)(.20)(8,760)\frac{1}{.80} = 71.4 \times 10^9$ Btu

Boiler #2

Heat Output $= (57.2 \times 10^9 \text{ Btu})\frac{(1)}{.85} - 61.3 \times 10^9 \text{ Btu} = 6.0 \times 10^9$ Btu

Fuel $(M = .80) = 6.0 \times 10^9 \text{ Btu } \frac{(1)}{.80} = 7.5 \times 10^9$ Btu

Snow Machine - CoP = 15. Electricity $= (2,700 \text{ Mwh load}) \frac{(1)}{.85} \frac{(1)}{15} = 212$ Mwh

Total Thermal 78.9×10^9 Btu

Electrical Load 10.4×10^6 Kwh
Snow 0.21×10^6 Kwh

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Scenario 2

CB Existing Boilers and Winter Ice Storage

Capital Cost

Energy Production	\$1,249,000	
Distribution	\$1,830,000	\$3,079,000

1st Year Fuel Cost (#6 oil; 0.5% Sulfur)

$(78.9 \times 10^9$ Btu/yr$) / (143 \times 10^3$ Btu/gal$) =$
Usage = 551,748 gal/yr

Cost = (551,748 gal/yr) (\$.876/gal) = \$483,331/yr

1st Year Misc. 10% of central plant cost - \$124,900

Extra ice labor: 1½ snow operators
1½ @ \$17,000/yr + overhead 50,000 \$174,900/yr

1st Year Elec Cost

Residential use: same as Scenario #1: \$63,373/month
Snow: (210,000 Kwh) (\$0.3309/Kwh) + (210,000 Kwh)(\$.04 Kwh)
= \$153,447/yr \$913,923

Scenario 2

CB Boilers W/Winter Ice Storage Short-Term Thermal Storage

Year	Capital Payment ($\$ \times 10^3$)	Fuel Cost ($\$ \times 10^3$)	Misc. ($\$ \times 10^3$)	Elec. Cost ($\$ \times 10^3$)	Net Annual Cost ($\$ \times 10^3$)	Present Worth Factor (=10%)	Total Present Worth of Cost ($\$ \times 10^3$)
1984	339	483	175	914	1,911	.9091	1,737
1985	339	524	184	992	2,039	.8264	1,685
1986	339	569	193	1,076	2,177	.7513	1,636
1987	339	617	203	1,167	2,326	.6830	1,589
1988	339	669	213	1,267	2,488	.6209	1,545
1989	339	726	223	1,374	2,662	.5645	1,503
1990	339	788	235	1,491	2,853	.5132	1,464
1991	339	855	246	1,618	3,058	.4665	1,427
1992	339	928	259	1,755	3,281	.4241	1,391
1993	339	1,007	271	1,905	3,522	.3855	1,358
1994	339	1,092	285	2,067	3,783	.3505	1,326
1995	339	1,185	299	2,242	4,065	.3186	1,295
1996	339	1,286	314	2,433	4,372	.2897	1,267
1997	339	1,395	330	2,640	4,704	.2633	1,239
1998	339	1,513	346	2,864	5,062	.2394	1,212
1999	339	1,642	364	3,107	5,452	.2176	1,186
2000	339	1,782	382	3,371	5,874	.1978	1,162
2001	339	1,933	401	3,658	6,331	.1799	1,139
2002	339	2,097	421	3,969	6,826	.1635	1,116
2003	339	2,276	442	4,306	7,363	.1486	1,094
2004	339	2,569	464	4,672	8,044	.1351	1,087
2005	339	2,679	488	5,070	8,576	.1228	1,053
2006	339	2,907	512	5,500	9,258	.1117	1,034
2007	339	3,154	538	5,968	9,999	.1015	1,015
2008	339	3,423	564	6,475	10,801	.0923	997

Present Worth of Lifecycle Costs $32,557,000

Scenario 3

Cogenerator, CB Boilers, Absorbtion Chiller With Thermal Storage

Capital Cost

Energy Production	\$1,970,000	
Distribution	\$1,830,000	
		\$3,800,000

1st Year Fuel Cost

Cogenerator: (#2 oil; 0.5%S)
$(4.20 \times 10^9$ Btu$)/(136 \times 10^3$ Btu/gal$)$ = 308,824/gal/yr
(308,824/gal/yr) (\$.94/gal) = \$290,295

Boilers: (#6 oil; 0.5%S)
$(72.1 \times 10^9$ Btu$)/(134 \times 10^3$ Btu/gal$)$ = 538,060 gal/yr
(538,060 gal/yr) (\$.876/gal) = \$471,341 — \$761,636/yr

1st Year Misc. (10% of Central Plant Cost) — \$197,000/yr

1st Year Elec Cost (k-rate) (master-metered apt. building)

buy 5.17×10^5 Kwh/month

6.2×10^6 Kwh/yr

Each month: (120 Kwh)(\$.0698) + (517,000 Kwh-120 Kwh)(\$.03309/Kwh) + (517,000 Kwh)(\$.04 Kwh)

= \$8.38 + \$17,104 + \$20,680
= \$37,792/month — \$453,509/yr

1st Year Elec Revenue

(500,000 Kwh/yr excess) (.04/Kwh) — \$20,000

Scenario 3

Cogenerator, CB Boilers, and Absorption Chiller

Cost

Central Plant

Boilers (relocate, start-up)		$ 30,000	
Heat Exchangers (for 3 boilers)		20,000	
Cogenerator Engine	600 KWe	720,000	
Chiller/Heater	300 ton	120,000	
Absorption Chiller (base, above chiller heater	1,000 tons	190,000	
Chiller (electric) (back-up)	500 ton	80,000	
Thermal Storage	375,000 gal	140,000	
Subtotal			$1,300,000
Contingency - 50%		$ 650,000	
Total			$1,970,000
Distribution		$1,830,000	
Total			$3,800,000

Fuel Requirements (annual)

Cogenerator — Heat Output = 25.2×10^9 Btu — Electric Output = 4,200 Mwh

Fuel = 42.0×10^9 Btu

Boilers — Heat Output = $(73.5 \times 10^9 \text{ Btu}) \frac{(1)}{.85} - 25.2 \times 10^9 \text{ Btu} = 61.3 \times 10^9$ Btu

Fuel (M =.85) = 72.1×10^9 Btu

Boiler #1 used as base above chiller/heater and charge storage

Boiler #2 and #3 back-up

Total Thermal 114.1×10^9 Btu

Electrical
1) Assuming sell excess power at purchase rate 6.2×10^6 Kwh
2) Assuming sell excess at .50 purchase, excess = 500 Mwh 6.5×10^6 Kwh

Scenario 3

Cogenerator, CB Boilers Absorbtion Chiller With/Short-Term Thermal Storage

Year	Capital Payment ($\$\times10^3$)	Fuel Cost ($\$\times10^3$)	Misc. ($\$\times10^3$)	Elec. Cost ($\$\times10^3$)	Elec Revenue ($\$ 10^3$)	Net Annual Cost ($\$\times10^3$)	Present Worth Factor (=10%)	Total Present Worth of Cost ($\$\times10^3$)
1984	419	762	197	454	20	1,812	.9091	1,647
1985	419	827	207	493	22	1,924	.8264	1,590
1986	419	897	217	534	24	2,043	.7513	1,535
1987	419	973	228	580	26	2,174	.6830	1,485
1988	419	1,056	239	629	28	2,371	.6209	1,472
1989	419	1,146	251	683	30	2,469	.5645	1,394
1990	419	1,243	264	741	33	2,634	.5132	1,352
1991	419	1,349	277	804	35	2,814	.4665	1,313
1992	419	1,464	291	872	38	3,008	.4241	1,276
1993	419	1,588	306	946	42	3,217	.3855	1,240
1994	419	1,723	321	1,026	45	3,444	.3505	1,207
1995	419	1,869	337	1,114	49	3,690	.3186	1,176
1996	419	2,028	354	1,208	53	3,956	.2897	1,146
1997	419	2,201	371	1,311	58	4,244	.2633	1,117
1998	419	2,388	390	1,423	63	4,557	.2394	1,091
1999	419	2,591	410	1,543	68	4,895	.2176	1,065
2000	419	2,811	430	1,675	74	5,261	.1978	1,041
2001	419	3,050	452	1,817	80	5,658	.1799	1,018
2002	419	3,309	474	1,971	87	6,086	.1635	995
2003	419	3,590	498	2,139	94	6,552	.1486	974
2004	419	3,895	523	2,321	102	7,056	.1351	953
2005	419	4,226	549	2,518	111	7,601	.1228	933
2006	419	4,586	576	2,732	120	8,193	.1117	915
2007	419	4,976	605	2,964	131	8,833	.1015	897
2008	419	5,398	635	3,216	142	9,526	.0923	879
			Present Worth of Lifecycle Costs					$29,711,000

PL5/I/102683

Boston Housing Authority, att John Stainton
Boston Redevelopment Authority, att William Whitman
Corcoran, Mullins & Jennison, att Marty Jones
Housing Associates, att Bob Kuehn

Columbia Point - Energy efficient buildings and systems

This is a proposal for a survey and analysis of energy conservation strategies and energy supply options for the redevelopment of Boston's Columbia Point. The project's objective is to present and analyze the cost and benefits of alternative combinations of energy saving steps in the buildings and in the energy supply systems for heating and domestic hot water.

The effort proposed would be a collaborative venture of the MIT Program for Energy Efficient Buildings and Systems and a Swedish team from Triark-Procedum and Studsvik Energiteknik AB. The Swedish team has extensive experience with development of state-of-the-art energy supply projects for multi-family buildings in Sweden. We propose to work closely with the Boston Housing Authroity, the Boston Redevelopment Authority, and the involved developers to insure that our analysis reflects the specific evaluative criteria of those who will develop and manage the project.

Alternative strategies and options will be analyzed against a number of criteria, including capital and operating costs and benefits; performance reliability; maintenance requirements; desirable indoor climate and environment; engineering feasibility; and practicality in terms of the overall projects development schedule.

Strategies and Options to be Reviewed

Our analysis will focus on the three elements of a comprehensive energy program:

- Conservation steps to reduce demand for energy with the new and retrofitted buildings. Among the options to be reviewed are: review of building orientation, structures and floor-plans; added insulation in external walls, the attic, and under the first floor; improved air-tightness in external walls; design of, and new materials for doors and windows; controlled ventilation for heat recovery of exhaust air; etc.
- Heating supply systems in the buildings. Options include radiators with hot water, warm (and cool) air, electricty, heat pump systems, and combination.
- Heating distribution systems. The options of potential use will be dependent on the energy supply need. The less energy needed the more possibilities there are to use alternative and local energy sources as well as the distribution of lower temperatures through the system. Among the alternatives to be considered are the use of large-scale heat pumps to make use of sea water, ground water and sewage.

The product of our work will be recommendation of selected feasible options to create energy and cost efficient heating and cooling. It will also include recommendations for system management and maintenance. We will also suggest approaches which might be used to select a final solution for the energy system at Columbia Point. Our findings will be presented in meetings with the BRA, BHA, and the developers as well as in a written report.

Project Approach

The period for this project will be two to three months. The first major activity of our work will be a carefully planned workshop involving the BHA, BRA, the developers and our entire team. In one or two half-day sessions we will review the present development plans and schedules for Columbia Point's overall development and the present strategies for energy supply and management. We will also review and discuss performance criteria which the developers have for the energy systems. Our team will discuss those plans in light of available knowledge and experience from Sweden and the United States. Together, the group will select a limited number of questions and options to be analyzed during the study period.

Our team will spend the next month exploring and analyzing options. We will do this in collaboration with staff of any of the involved organizations which would like to participate in this aspect of the work.

In the latter part of the second month of our work our team will meet for a second formal meeting with the BHA, BRA and developers. We will present our findings and discuss options for further work. We will be available in the days immediately following this meeting for more detailed discussions with the groups as a whole or with staff of the individual organizations.

Budget

The estimated cost for the project, including the work of the Swedish team, will be $25,000.

For practical administrative reasons we suggest that the contract for this project will be signed by Metcalf & Eddy-FVB District Heating Engineering Inc. FVB-District Heating Engineering Inc. is the American subsidiary of Studsvik Energiteknik AB. MIT and Triark-Procedum will be subcontractors. The involved experts in this project are:

- Thomas Bligh, MIT Assistant Professor, Mechanical Engineering
- Leon Glicksman, Director, MIT Program for Energy Efficient Buildings and Systems
- Hans Gransell, MS, Studsvik/FVB
- Michael Joroff, Director, MIT Laboratory of Architecture and Planning
- Claes Reuterskiold, MA, Triark-Procedum; MIT Visiting Research Scientist; project leader

Goran Rygert, MA, Triark-Procedum, multi-family energy conservation expert
Richard Tabors, PhD, MIT Energy Laboratory

My colleagues and I are particularly interested in this project. Its scale and strategy for development allows for an approach to energy planning and implementation innovative on the American scene. The combination of an MIT and a Swedish team will allow us to bring to bear state-of-the-art knowledge and implementation.

We look forward to hearing from you. Please do not hesitate to call Claes Reuterskiold should you want more information, (617) 253-1350.

Sincerely,

Claes Reuterskiold

Claes Reuterskiold for
Birger Abrahamson
President of FVB
for Metcalf & Eddy - FVB District Heating Engineering Inc.
Representing Studsvik Energiteknik AB in the United States

APPENDIX O

NOISE LEVEL EVALUATION

Worksheet A
Site Evaluation

Site Location

COLUMBIA POINT (DORCHESTER) MA

Program

Project Name

HARBOR POINT REDEVELOPMENT

Locality

MT. VERNON ST. - EXISTING BUILDING #27 SOUTHEAST CORNER

File Number

463

Sponsor's Name

Phone

Street Address

City, State

	Acceptability Category	DNL	Predicted for Operations in Year
1. Roadway Noise		53.5	1984
2. Aircraft Noise		55	1982 (Latest available)
3. Railway Noise			

Value of DNL for all noise sources: (see page 3 for combination procedure) 57.3

Final Site Evaluation (circle one)

Acceptable

Normally Unacceptable

Unacceptable

Signature

Date

Clip this worksheet to the top of a package containing Worksheets B-E and Workcharts 1-7 that are used in the site evaluations

List all major roads within 1000 ft of the site:

1. Mount Vernon Street
2.
3.
4.

Necessary Information	Road 1	Road 2	Road 3	Road 4
1. Distance in feet from the NAL to the edge of the road				
a. nearest lane	120			
b. farthest lane	180			
c. average (effective distance)	150			
2. Distance to stop sign	–			
3. Road gradient in percent	<2%			
4. Average speed in mph				
a. Automobiles	35			
b. heavy trucks - uphill				
c. heavy trucks - downhill				
5. 24 hour average number of automobiles and medium trucks in both directions (ADT)				
a. automobiles	5168			
b. medium trucks	52			
c. effective ADT (a + (10xb))	5688			
6. 24 hour average number of heavy trucks				
a. uphill				
b. downhill				
c. total				
7. Fraction of nighttime traffic (10:00 p.m. to 7: a.m.)	10%			
8. Traffic projected for what year?	1984			

Adjustments for Automobile Traffic

	9 Stop and-go Table 3		10 Average Speed Table 4		11 Night-Time Table 5		12 Auto ADT (line 5c)		13 Adjusted Auto ADT	14 DNL (Workchart 1)		15 Barrier Attenuation		16 Partial DNL
Road No. 1		X	0.40	X	0.81	X	5688	=	1843		–		=	53.5
Road No. 2		X		X		X		=			–		=	
Road No. 3		X		X		X		=			–		=	
Road No. 4		X		X		X		=			–		=	

Adjustments for Heavy Truck Traffic

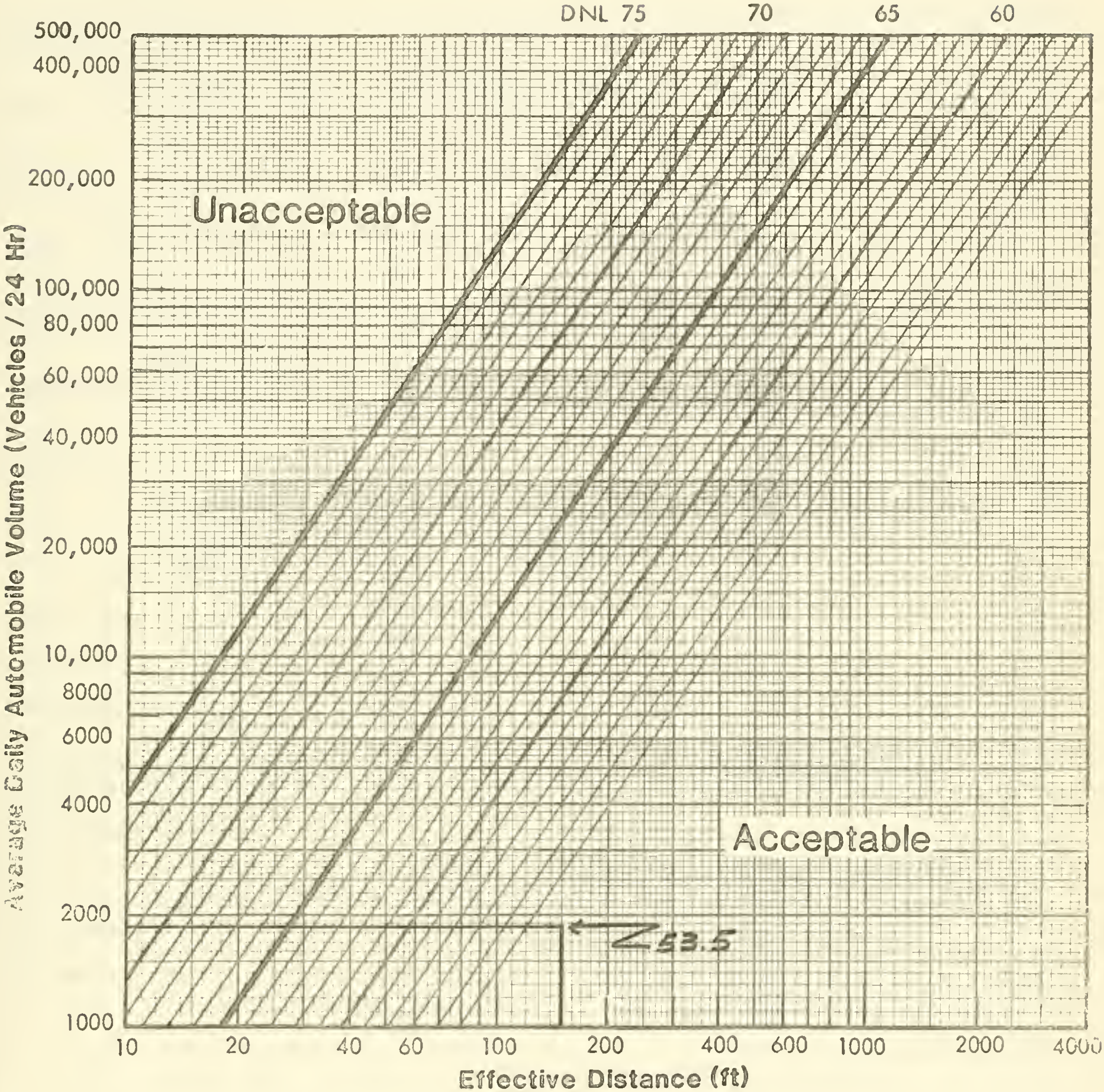
		17 Gradient Table 6		18 Average Speed Table 7		19 Truck ADT/2		20	21		22 Stop and-go Table 8		23 Night-Time Table 5		24 Adjusted Truck ADT	25 DNL (Work chart 2)		26 Barrier Attn.		27 Partial DNL
Road No. 1	Uphill		X		X		=													
									Add	X		X		=			–		=	
	Downhill				X		=													
Road No. 2	Uphill		X		X		=													
									Add	X		X		=			–		=	
	Downhill				X		=													
Road No. 3	Uphill		X		X		=													
									Add	X		X		=			–		=	
	Downhill				X		=													
Road No. 4	Uphill		X		X		=													
									Add	X		X		=			–		=	
	Downhill				X		=													

Combined Automobile & Heavy Truck DNL

Road No. 1 ________ Road No. 2 ________ Road No. 3 ________ Road No. 4 ________ Total DNL for All Roads 53.5

Signature ______________________________ Date ______________

Workchart 1
Autos (55 mph)



Worksheet A
Site Evaluation

Site Location

COLUMBIA POINT (DORCHESTER) MA

Program

Project Name

HARBOR POINT REDEVELOPMENT

Locality

MT. VERNON ST EXISTING BUILDING #27

File Number

463

Sponsor's Name

Phone

Street Address

City, State

	Acceptability Category	DNL	Predicted for Operations in Year
1. Roadway Noise		54.0	2000
2. Aircraft Noise		55.0	---
3. Railway Noise			
Value of DNL for all noise sources: (see page 3 for combination procedure)		57.5	

Final Site Evaluation (circle one)

Acceptable

Normally Unacceptable

Unacceptable

Signature

Date

Clip this worksheet to the top of a package containing Worksheets B-E and Workcharts 1-7 that are used in the site evaluations

List all major roads within 1000 ft of the site:

1. MOUNT VERNON ST
2.
3.
4.

Necessary Information	Road 1	Road 2	Road 3	Road 4
1. Distance in feet from the NAL to the edge of the road				
a. nearest lane	120			
b. farthest lane	180			
c. average (effective distance)	150			
2. Distance to stop sign	–			
3. Road gradient in percent	<2%			
4. Average speed in mph				
a. Automobiles	35			
b. heavy trucks - uphill				
c. heavy trucks - downhill				
5. 24 hour average number of automobiles and medium trucks in both directions (ADT)				
a. automobiles	6158			
b. medium trucks	62			
c. effective ADT (a + (10xb))	6778			
6. 24 hour average number of heavy trucks				
a. uphill	Neg			
b. downhill				
c. total				
7. Fraction of nighttime traffic (10:00 p.m. to 7: a.m.)	10%			
8. Traffic projected for what year?	2000			

Adjustments for Automobile Traffic

	9 Stop and-go Table 3		10 Average Speed Table 4		11 Night-Time Table 5		12 Auto ADT (line 5c)		13 Adjusted Auto ADT	14 DNL (Workchart 1)		15 Barrier Attenuation		16 Partial DNL
Road No. 1		X	.40	X	.81	X	6778	=	2196		–		=	54.0
Road No. 2		X		X		X		=			–		=	
Road No. 3		X		X		X		=			–		=	
Road No. 4		X		X		X		=			–		=	

Adjustments for Heavy Truck Traffic

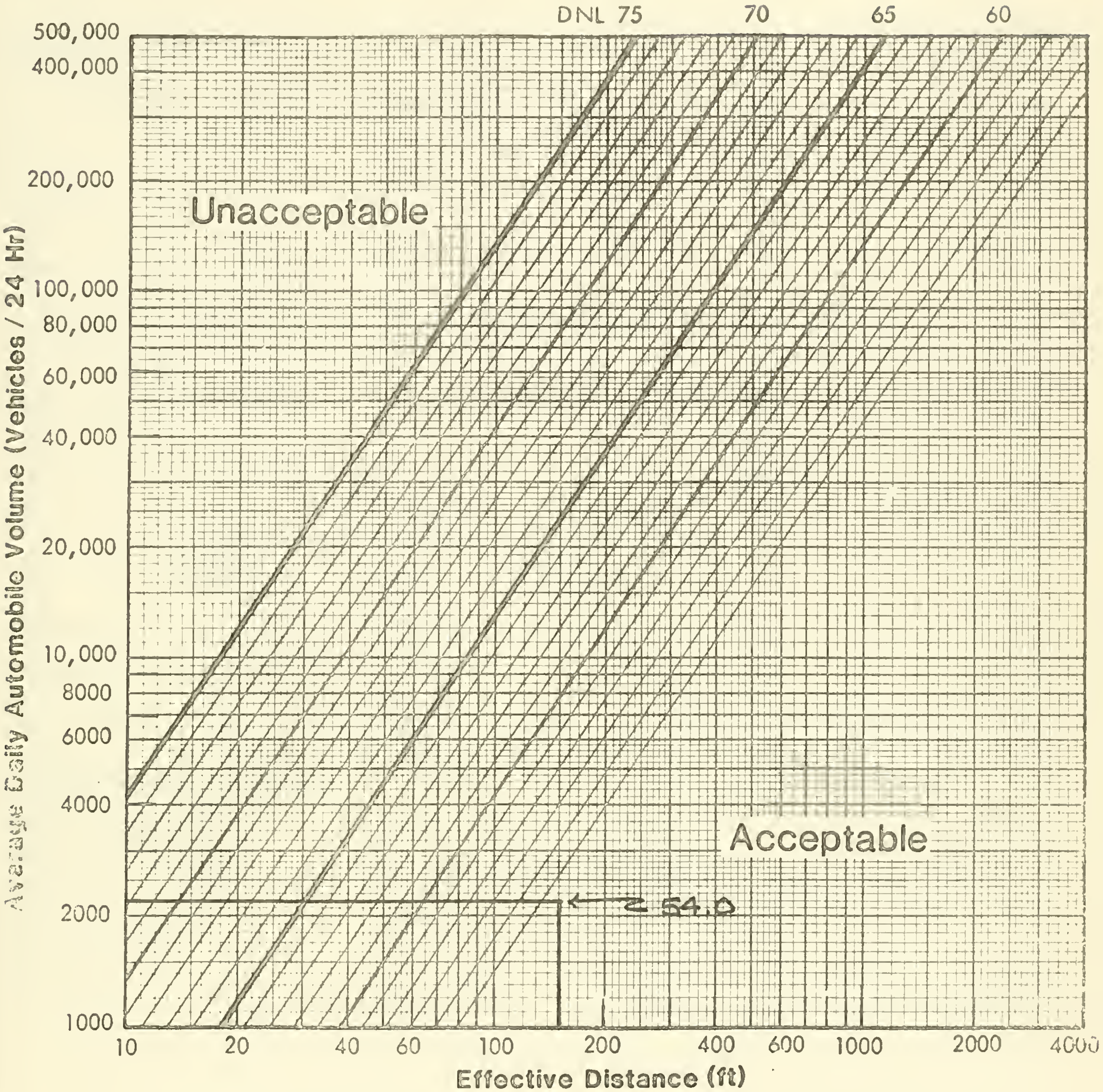
		17 Gradient Table 6		18 Average Speed Table 7		19 Truck ADT / 2		20		21		22 Stop and-go Table 8		23 Night-Time Table 5		24 Adjusted Truck ADT	25 DNL (Work chart 2)		26 Barrier Attn.		27 Partial DNL
Road No. 1	Uphill		X		X		=														
									Add		X		X		=			–		=	
	Downhill				X		=														
Road No. 2	Uphill		X		X		=														
									Add		X		X		=			–		=	
	Downhill				X		=														
Road No. 3	Uphill		X		X		=														
									Add		X		X		=			–		=	
	Downhill				X		=														
Road No. 4	Uphill		X		X		=														
									Add		X		X		=			–		=	
	Downhill				X		=														

Combined Automobile & Heavy Truck DNL

Road No. 1 ________ Road No. 2 ________ Road No. 3 ________ Road No. 4 ________ Total DNL for All Roads 54.0

Signature ________________________________ Date ________________

Workchart 1
Autos (55 mph)



Worksheet A
Site Evaluation

Site Location

COLUMBIA POINT (DORCHESTER) MA

Program

Project Name

HARBOR POINT REDEVELOPMENT

Locality

MT VERNON ST - PROP. TOWNHOUSE - SOUTHWEST CORNER

File Number

463

Sponsor's Name

Phone

Street Address

City, State

	Acceptability Category	DNL	Predicted for Operations in Year
1. Roadway Noise		59.5	1984
2. Aircraft Noise		Neg.	
3. Railway Noise		N.A.	
Value of DNL for all noise sources: (see page 3 for combination procedure)		59.5	

Final Site Evaluation (circle one)

Acceptable

Normally Unacceptable

Unacceptable

Signature ______________________ Date ______________

Clip this worksheet to the top of a package containing Worksheets B-E and Workcharts 1-7 that are used in the site evaluations

1984 Existing — Proposed Townhouse - Southwest Corner

List all major roads within 1000 ft of the site:

1. Mt. Vernon Street
2.
3.
4.

Necessary Information	Road 1	Road 2	Road 3	Road 4
1. Distance in feet from the NAL to the edge of the road				
a. nearest lane	60			
b. farthest lane	120			
c. average (effective distance)	90			
2. Distance to stop sign	N.A.			
3. Road gradient in percent	<2%			
4. Average speed in mph				
a. Automobiles	35			
b. heavy trucks - uphill				
c. heavy trucks - downhill				
5. 24 hour average number of automobiles and medium trucks in both directions (ADT)				
a. automobiles	9049			
b. medium trucks	90			
c. effective ADT (a + (10xb))	9959			
6. 24 hour average number of heavy trucks				
a. uphill				
b. downhill				
c. total	Neg.			
7. Fraction of nighttime traffic (10:00 p.m. to 7: a.m.)	10%			
8. Traffic projected for what year?	1984			

Adjustments for Automobile Traffic

	9 Stop and-go Table 3		10 Average Speed Table 4		11 Night-Time Table 5		12 Auto ADT (line 5c)		13 Adjusted Auto ADT	14 DNL (Workchart 1)		15 Barrier Attenuation		16 Partial DNL
Road No. 1		x	0.40	x	0.81	x	9959	=	3227		–		=	59.5
Road No. 2		x		x		x		=			–		=	
Road No. 3		x		x		x		=			–		=	
Road No. 4		x		x		x		=			–		=	

Adjustments for Heavy Truck Traffic

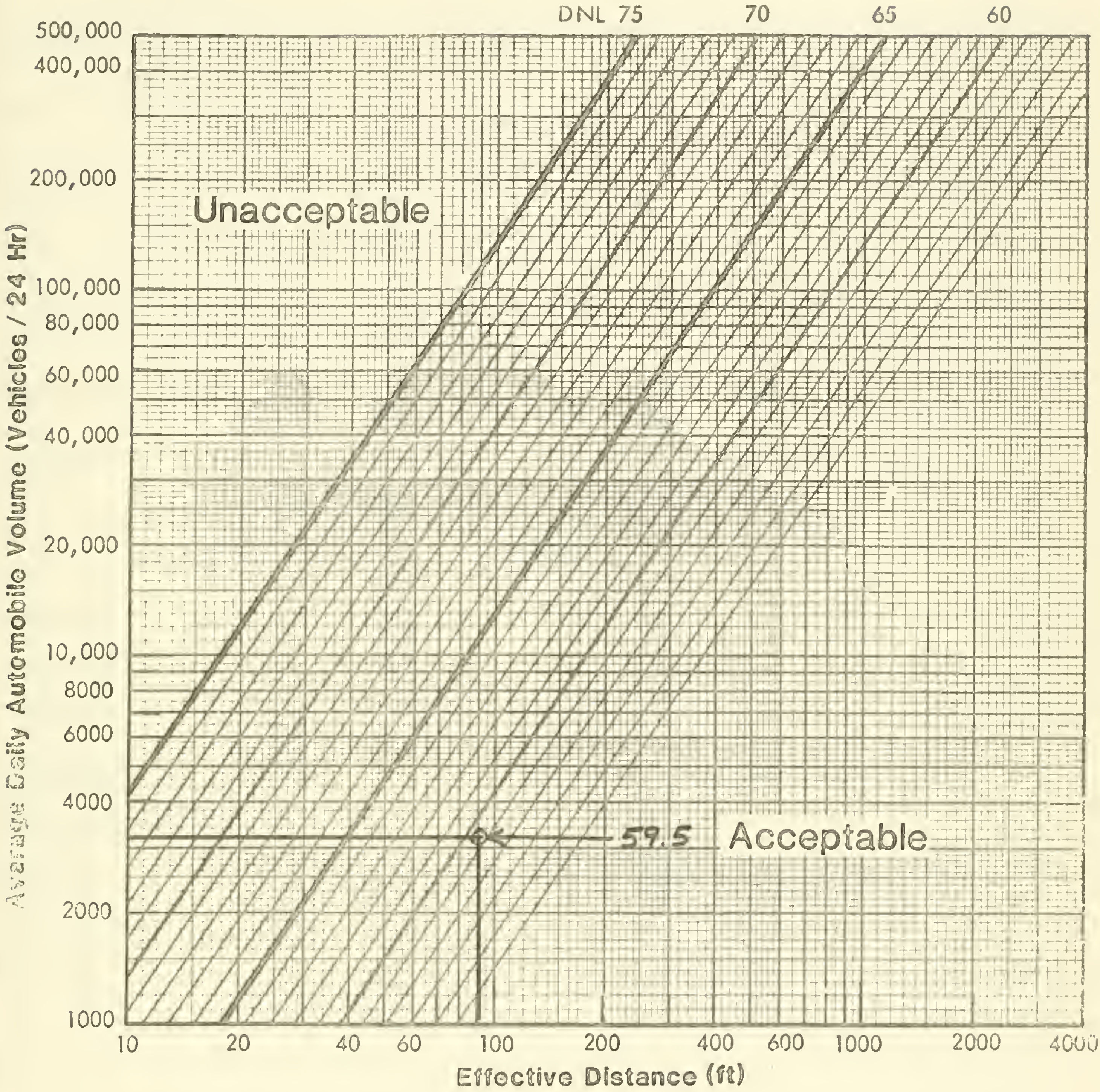
	17 Gradient Table 6		18 Average Speed Table 7		19 Truck ADT / 2		20	21		22 Stop and-go Table 8		23 Night-Time Table 5		24 Adjusted Truck ADT	25 DNL (Work chart 2)		26 Barrier Attn.		27 Partial DNL
Road No. 1 Uphill		X		X		=													
Road No. 1								Add	X		X		=			–		=	
Road No. 1 Downhill				X		=													
Road No. 2 Uphill		X		X		=													
Road No. 2								Add	X		X		=			–		=	
Road No. 2 Downhill				X		=													
Road No. 3 Uphill		X		X		=													
Road No. 3								Add	X		X		=			–		=	
Road No. 3 Downhill				X		=													
Road No. 4 Uphill		X		X		=													
Road No. 4								Add	X		X		=			–		=	
Road No. 4 Downhill				X		=													

Combined Automobile & Heavy Truck DNL

Road No. 1 ________ Road No. 2 ________ Road No. 3 ________ Road No. 4 ________ Total DNL for All Roads 59.5

Signature ____________________ Date ____________

Workchart 1
Autos (55 mph)



Worksheet A
Site Evaluation

Site Location

COLUMBIA POINT

Program

Project Name

HARBOR POINT REDEVELOPMENT

Locality

MT. VERNON ST. - PROP. TOWNHOUSE - SOUTHWEST CORNER

File Number

Sponsor's Name

Phone

Street Address

City, State

	Acceptability Category	DNL	Predicted for Operations In Year
1. Roadway Noise		62.0	2000
2. Aircraft Noise		Neg.	
3. Railway Noise		N.A.	
Value of DNL for all noise sources: (see page 3 for combination procedure)		62.0	

Final Site Evaluation (circle one)

Acceptable

Normally Unacceptable

Unacceptable

Signature

Date

Clip this worksheet to the top of a package containing Worksheets B-E and Workcharts 1-7 that are used in the site evaluations

List all major roads within 1000 ft of the site:

1. MT. VERNON ST.
2.
3.
4.

Necessary Information	Road 1	Road 2	Road 3	Road 4
1. Distance in feet from the NAL to the edge of the road				
a. nearest lane	60			
b. farthest lane	120			
c. average (effective distance)	90			
2. Distance to stop sign	N.A			
3. Road gradient in percent	<2%			
4. Average speed in mph				
a. Automobiles	35			
b. heavy trucks - uphill				
c. heavy trucks - downhill				
5. 24 hour average number of automobiles and medium trucks in both directions (ADT)				
a. automobiles	16117			
b. medium trucks	163			
c. effective ADT (a + (10xb))	17,747			
6. 24 hour average number of heavy trucks				
a. uphill	Neg.			
b. downhill				
c. total				
7. Fraction of nighttime traffic (10.00 p.m. to 7: a.m.)	10%			
8. Traffic projected for what year?	2000			

Adjustments for Automobile Traffic

	9 Stop and-go Table 3	10 Average Speed Table 4	11 Night-Time Table 5	12 Auto ADT (line 5c)	13 Adjusted Auto ADT	14 DNL (Workchart 1)	15 Barrier Attenuation	16 Partial DNL
Road No. 1		X 0.40	X 0.81	X 17,747	= 5,750		–	= 62.0
Road No. 2		X	X	X	=		–	=
Road No. 3		X	X	X	=		–	=
Road No. 4		X	X	X	=		–	=

Adjustments for Heavy Truck Traffic

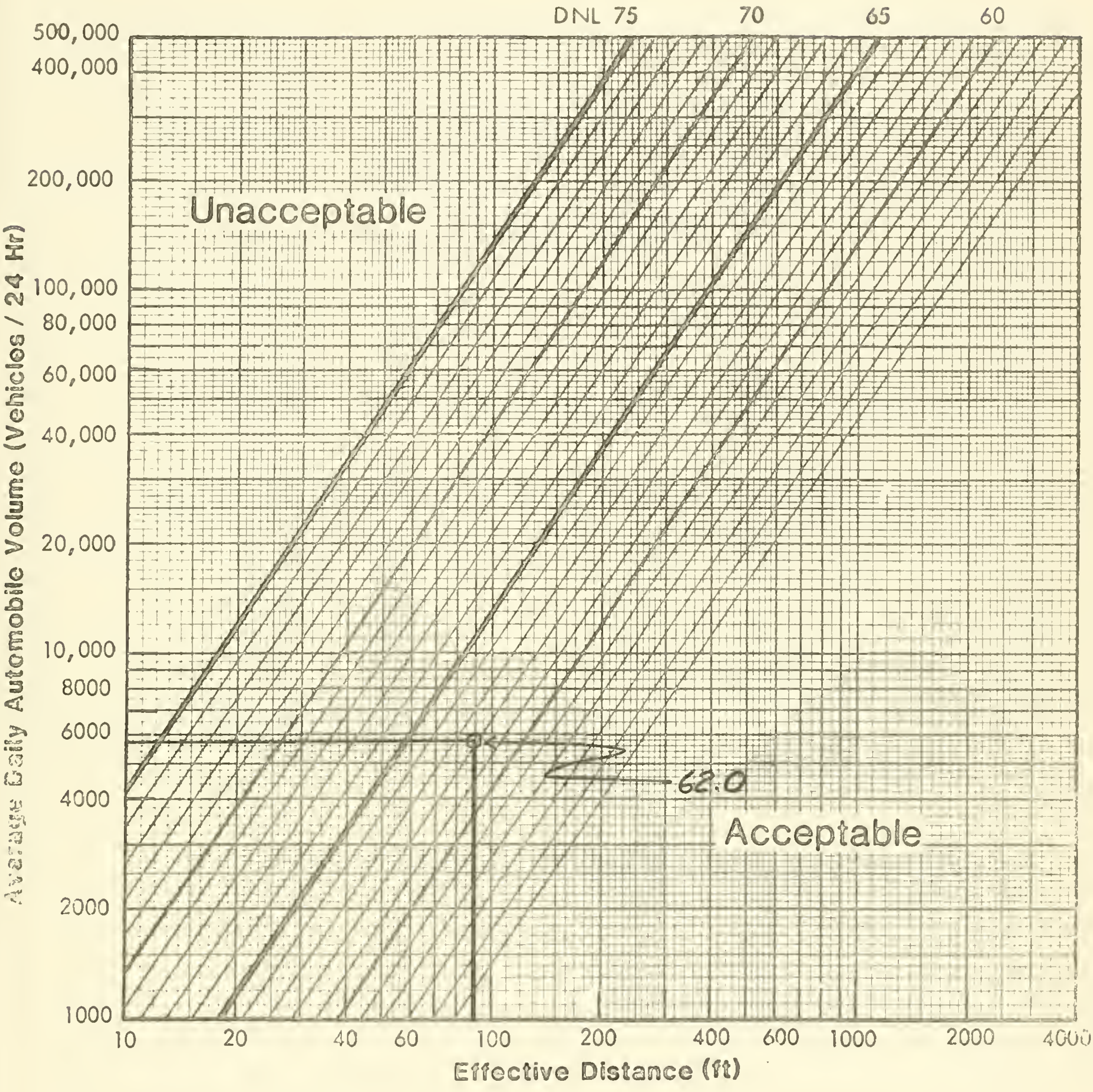
	17 Gradient Table 6	18 Average Speed Table 7	19 Truck ADT / 2	20	21	22 Stop and-go Table 8	23 Night-Time Table 5	24 Adjusted Truck ADT	25 DNL (Work chart 2)	26 Barrier Attn.	27 Partial DNL
Road No. 1 Uphill		X	X	=							
Road No. 1					Add	X	X	=		–	=
Road No. 1 Downhill			X	=							
Road No. 2 Uphill		X	X	=							
Road No. 2					Add	X	X	=		–	=
Road No. 2 Downhill			X	=							
Road No. 3 Uphill		X	X	=							
Road No. 3					Add	X	X	=		–	=
Road No. 3 Downhill			X	=							
Road No. 4 Uphill		X	X	=							
Road No. 4					Add	X	X	=		–	=
Road No. 4 Downhill			X	=							

Combined Automobile & Heavy Truck DNL

Road No. 1 ______ Road No. 2 ______ Road No. 3 ______ Road No. 4 ______ Total DNL for All Roads 62.0

Signature ______________________ Date ______________

Workchart 1
Autos (55 mph)



APPENDIX P

IMPACT ASSESSMENT OF PROPOSED STREET IMPROVEMENTS *

* Available from the Boston Redevelopment Authority

APPENDIX Q

EXAMPLES OF BOSTON'S LINEAR PARK SYSTEM

SOME EXAMPLES OF BOSTON'S LINEAR PARK SYSTEMS

A. Charles River, Watertown

B. Charles River, Watertown

C. Charles River, Cambridge

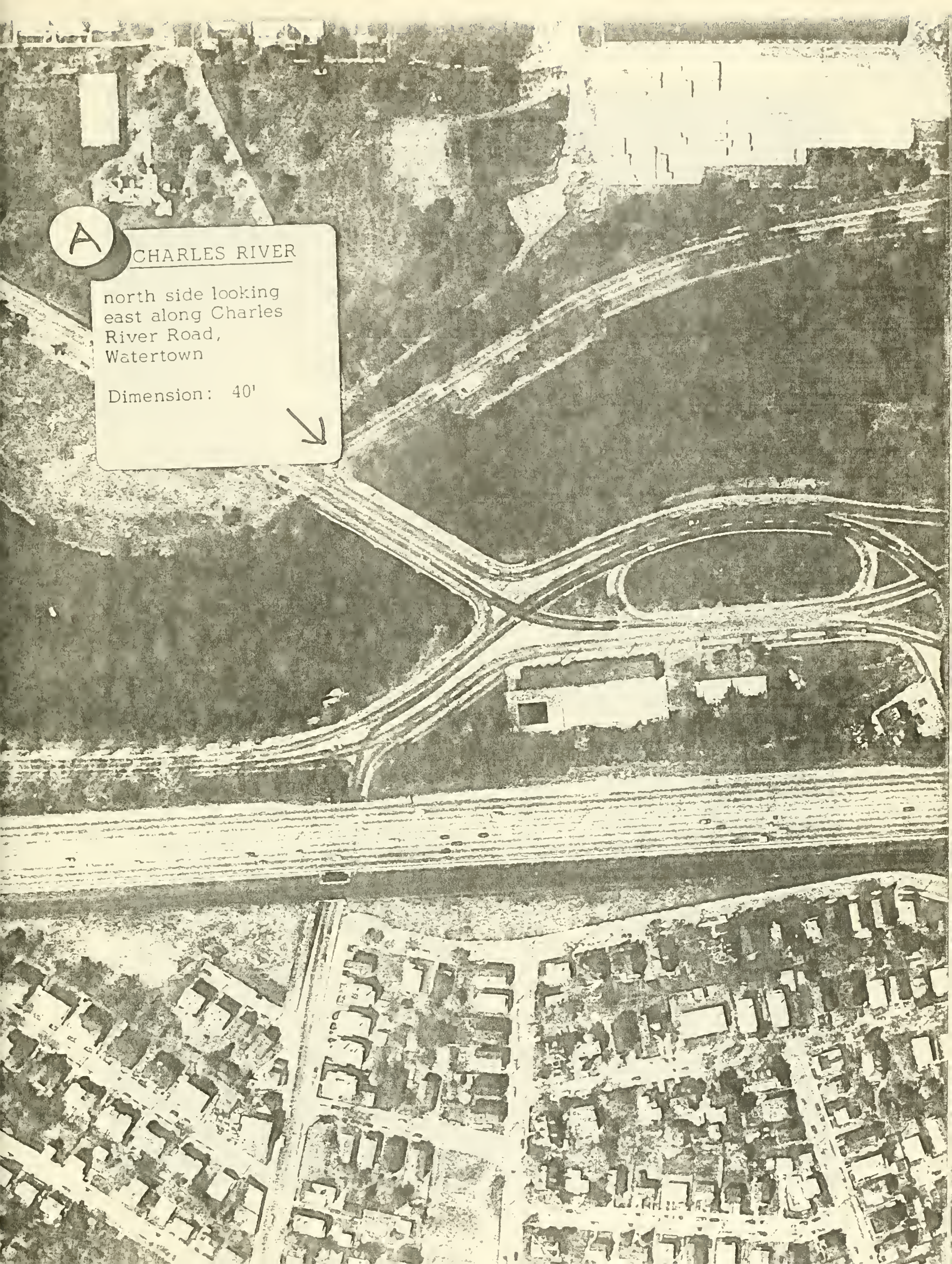
D. Charles River, Boston

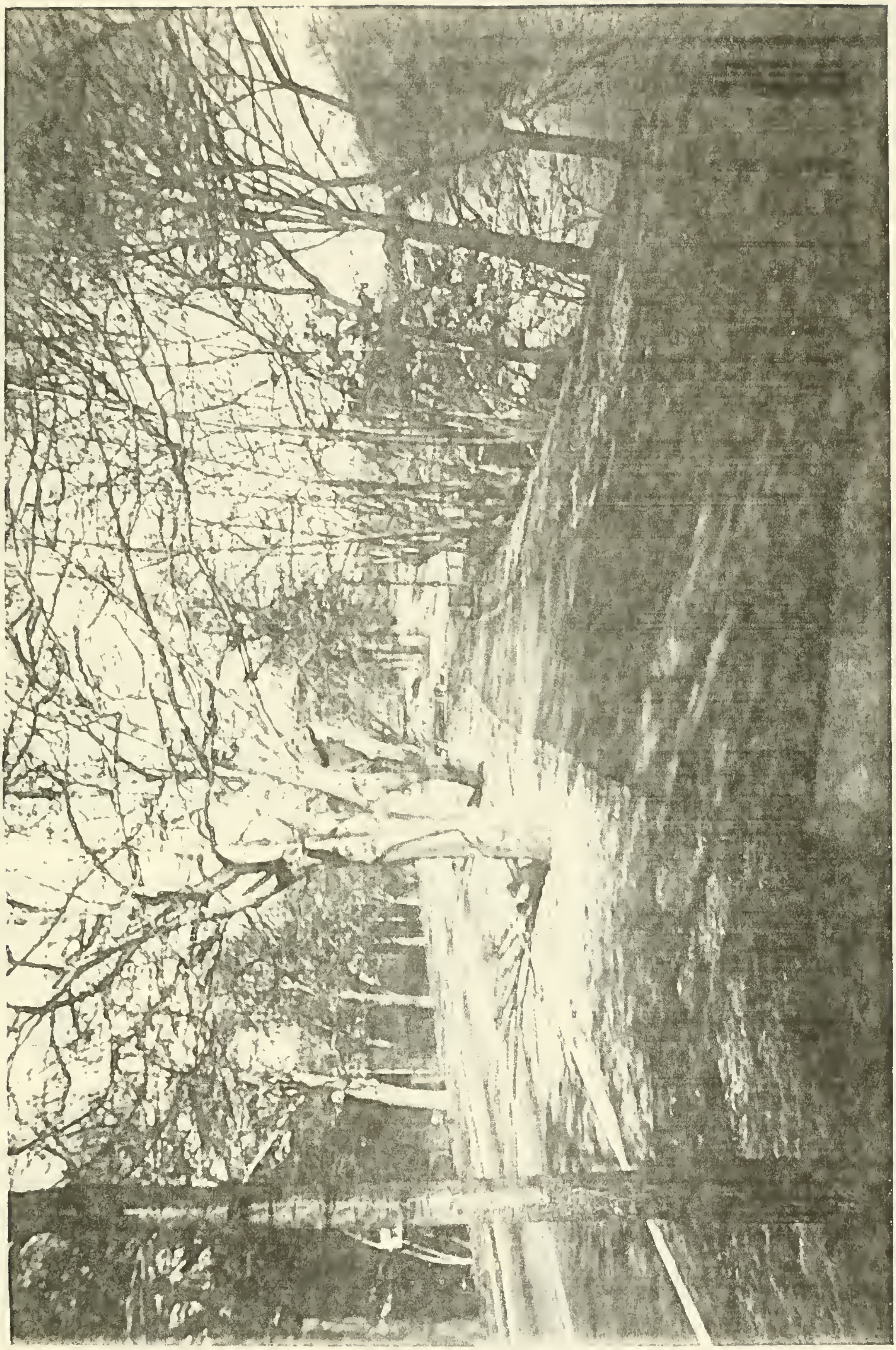
E. Boston Harbor, Boston

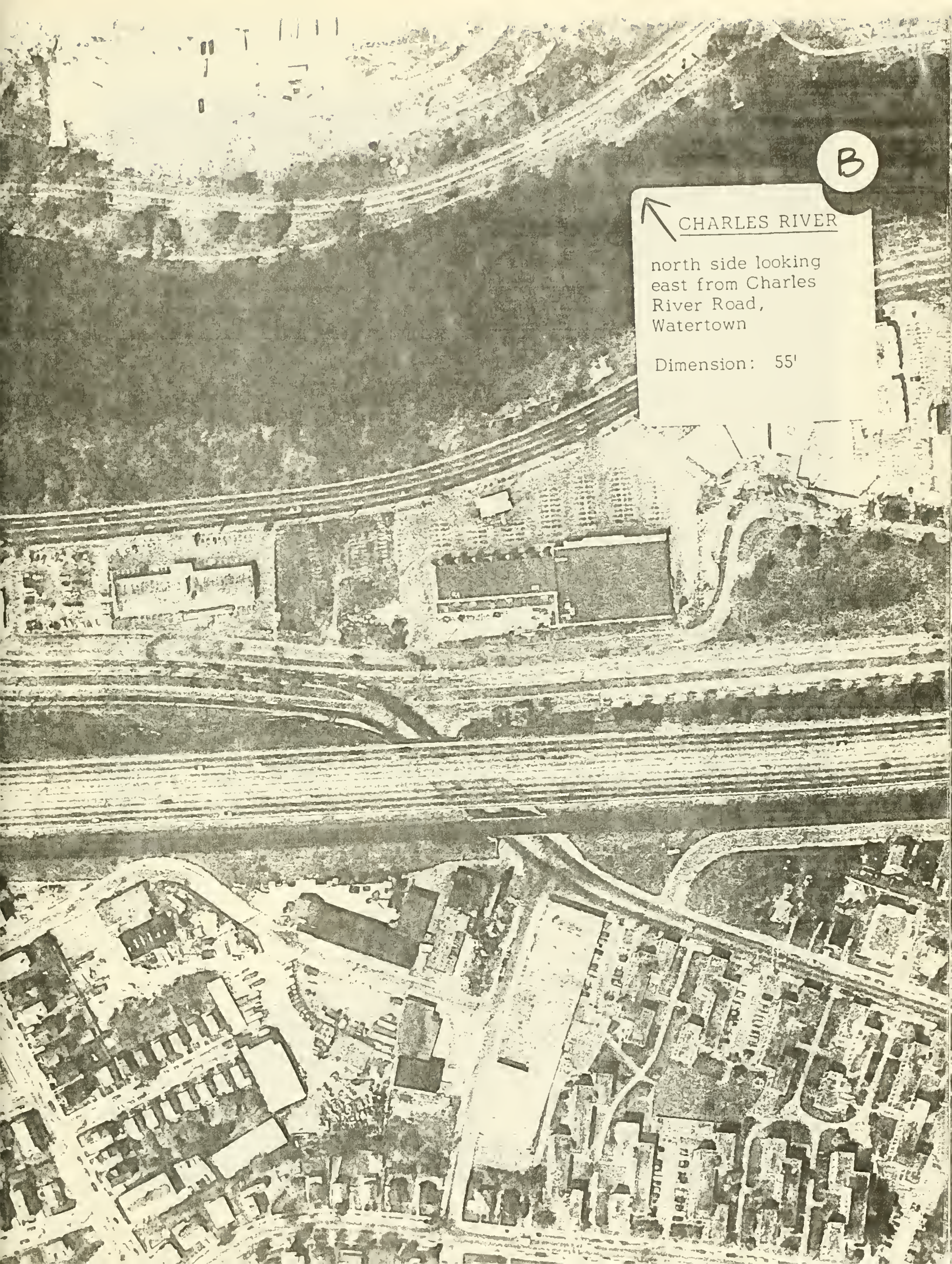
Note: Dimensions are taken from the edge of the road to the water's edge.

Aerial photos scale: 1" = 200'

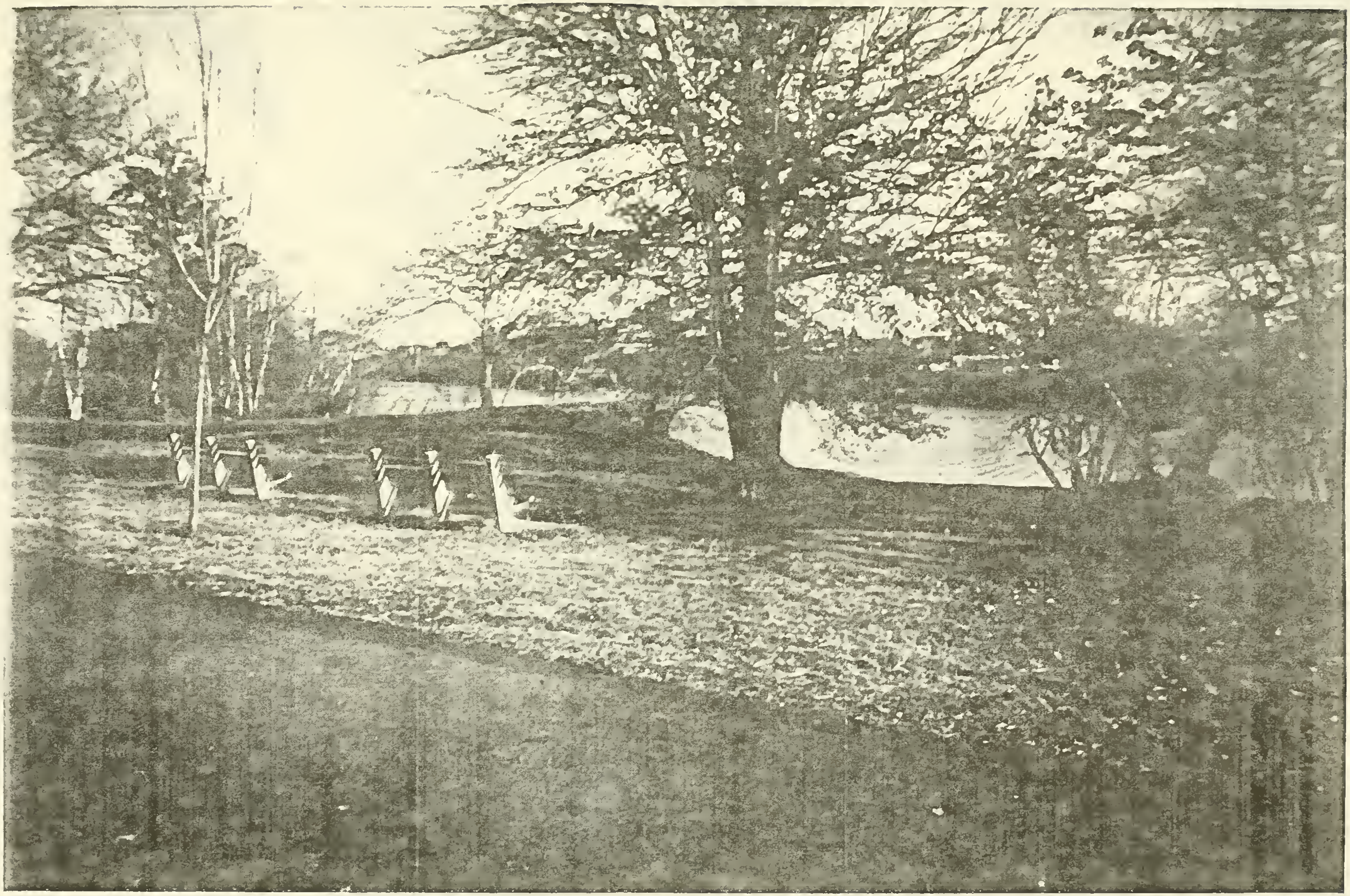
READING
BURLINGTON
WAKEFIELD
BEDFORD
WOBURN
STONEHAM
LEXINGTON
WINCHESTER
MELROSE
SAUGUS
MEDFORD
MALDEN
ARLINGTON
REVERE
EVERETT
WALTHAM
BELMONT
SOMERVILLE
CHELSEA
CAMBRIDGE
BOSTON
A
B
C
D
E
NEWTON
BROOKLINE
WELLESLEY
NEEDHAM
DEDHAM
MILTON
QUINCY
BRAINTREE
Westwood
Islington
Dover
Minute Man National Historic Park
Middlesex Fells Reservation
Harvard University
Brandeis University
Boston College
Jamaica Plain
Roxbury
Dorchester
Mattapan
Hyde Park
Roslindale
West Roxbury
Blue Hills


A
CHARLES RIVER
north side looking east along Charles River Road, Watertown
Dimension: 40'

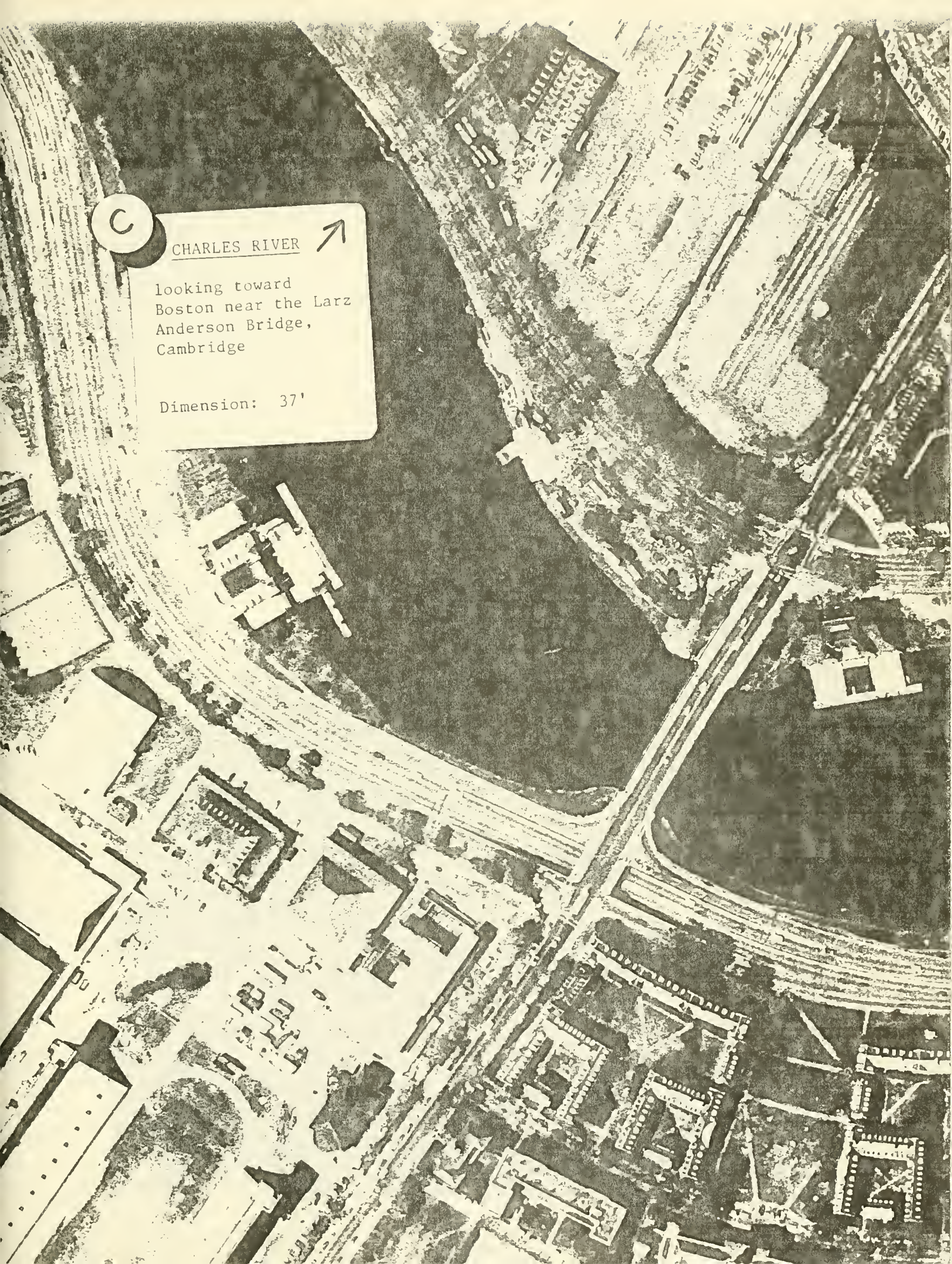




B
CHARLES RIVER
north side looking
east from Charles
River Road,
Watertown
Dimension: 55'



B

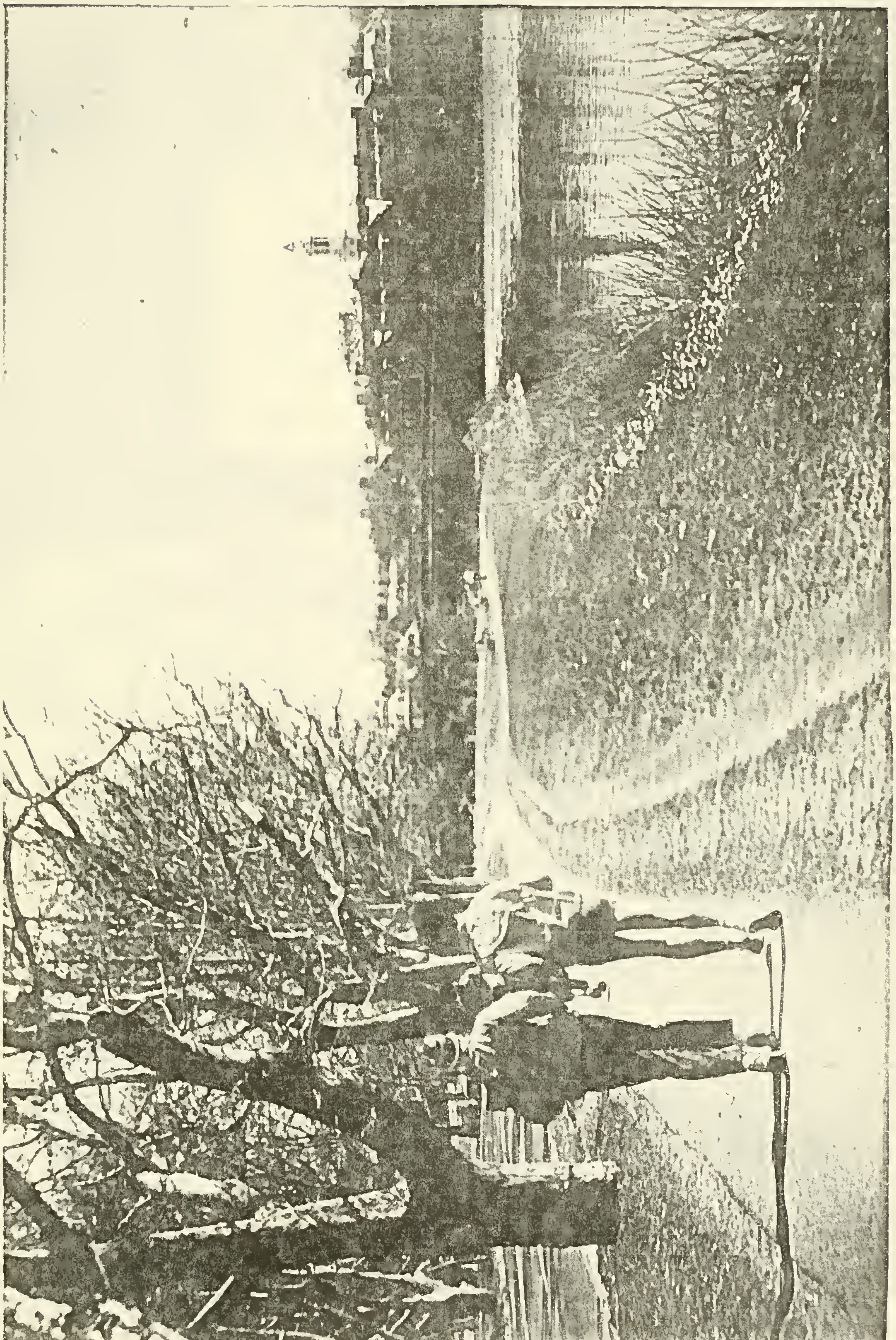


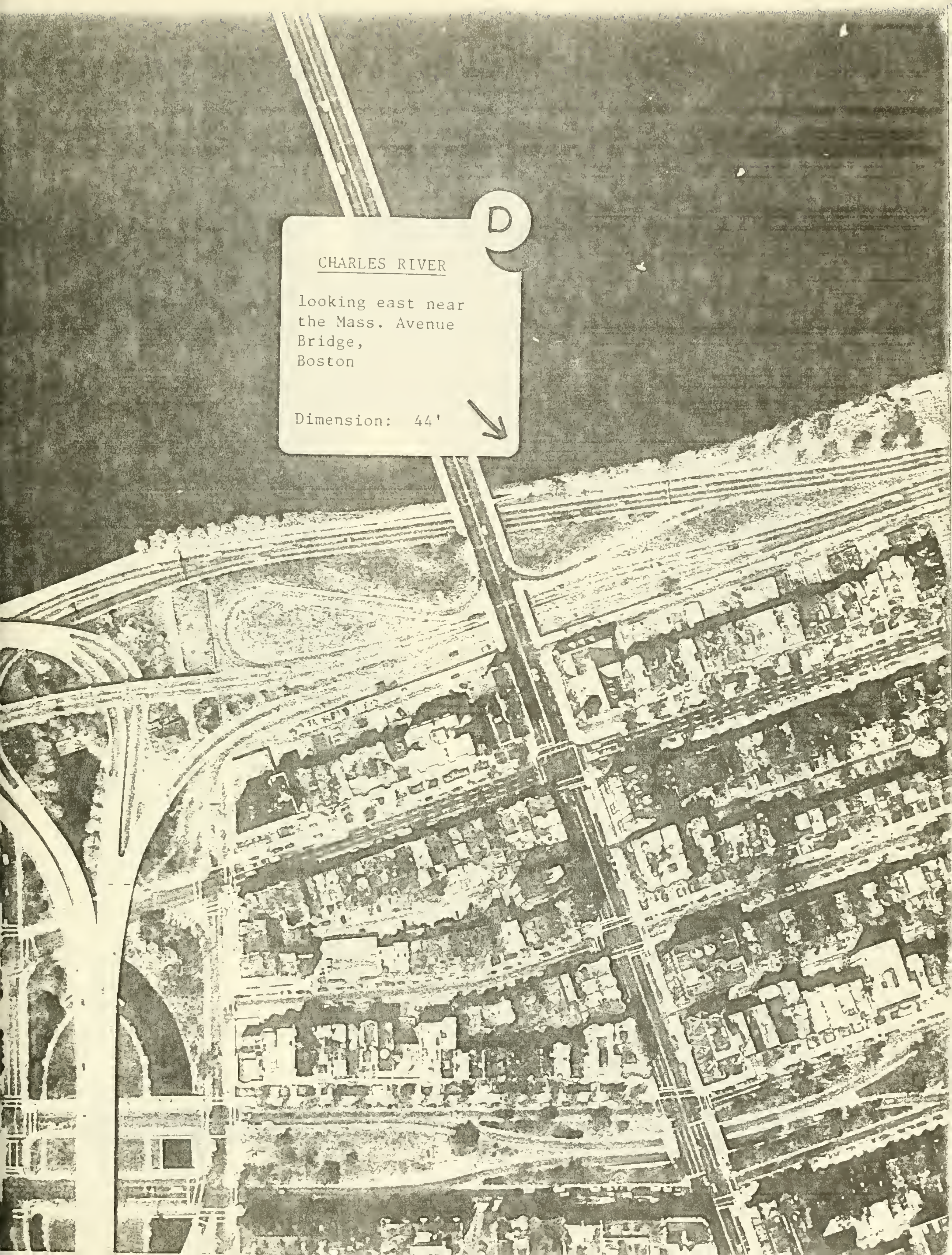
C

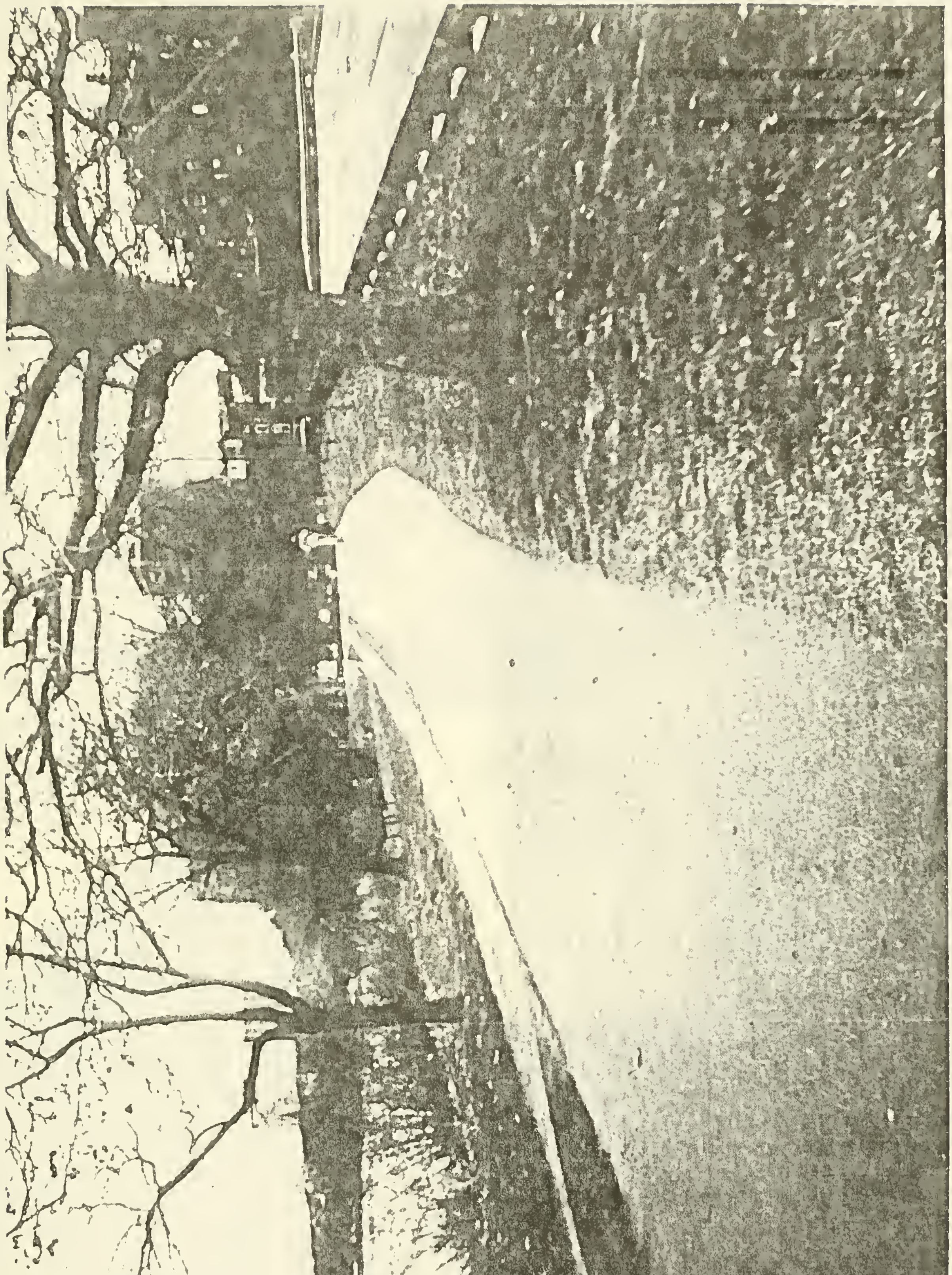
CHARLES RIVER ↗

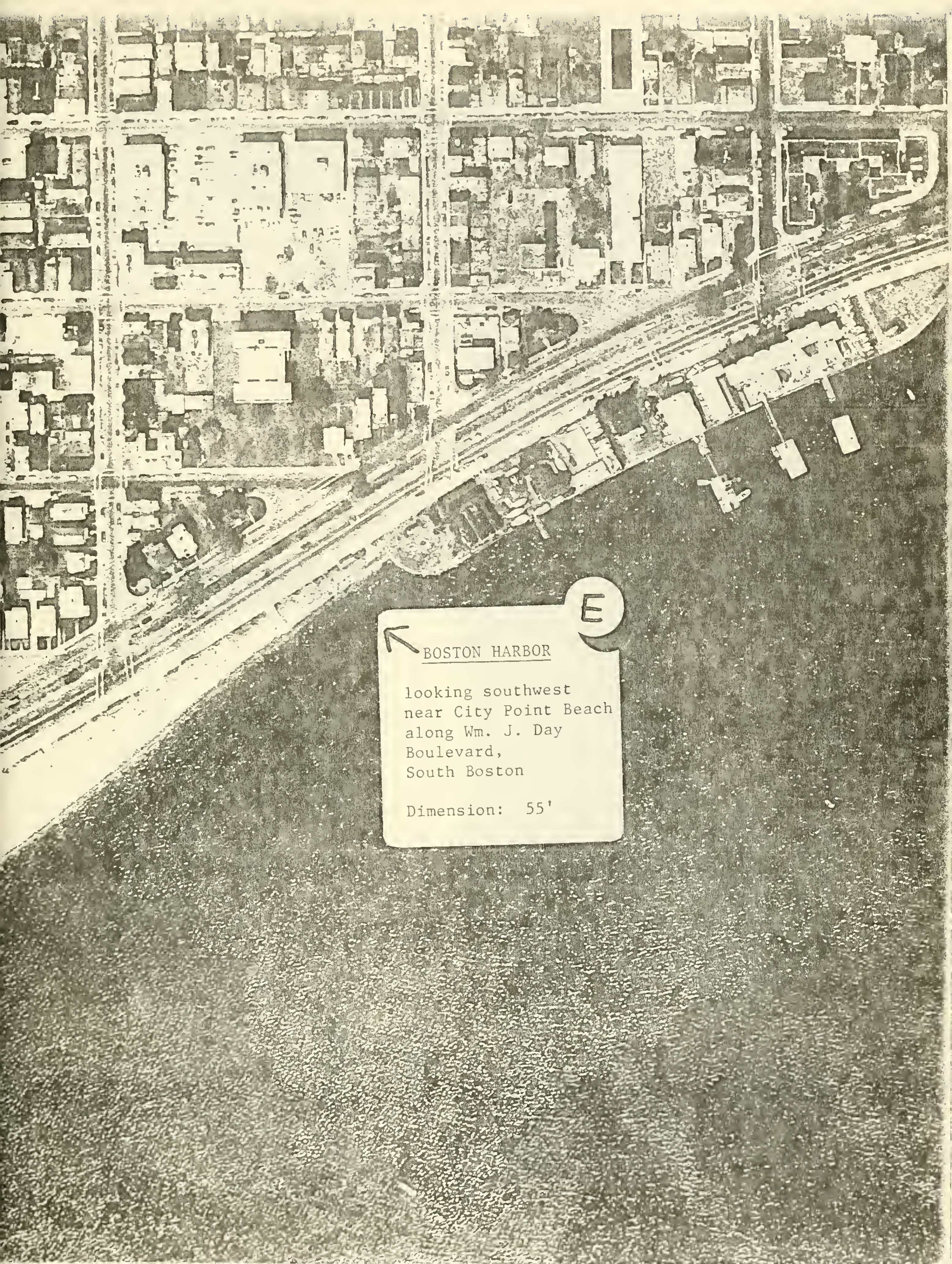
looking toward Boston near the Larz Anderson Bridge, Cambridge

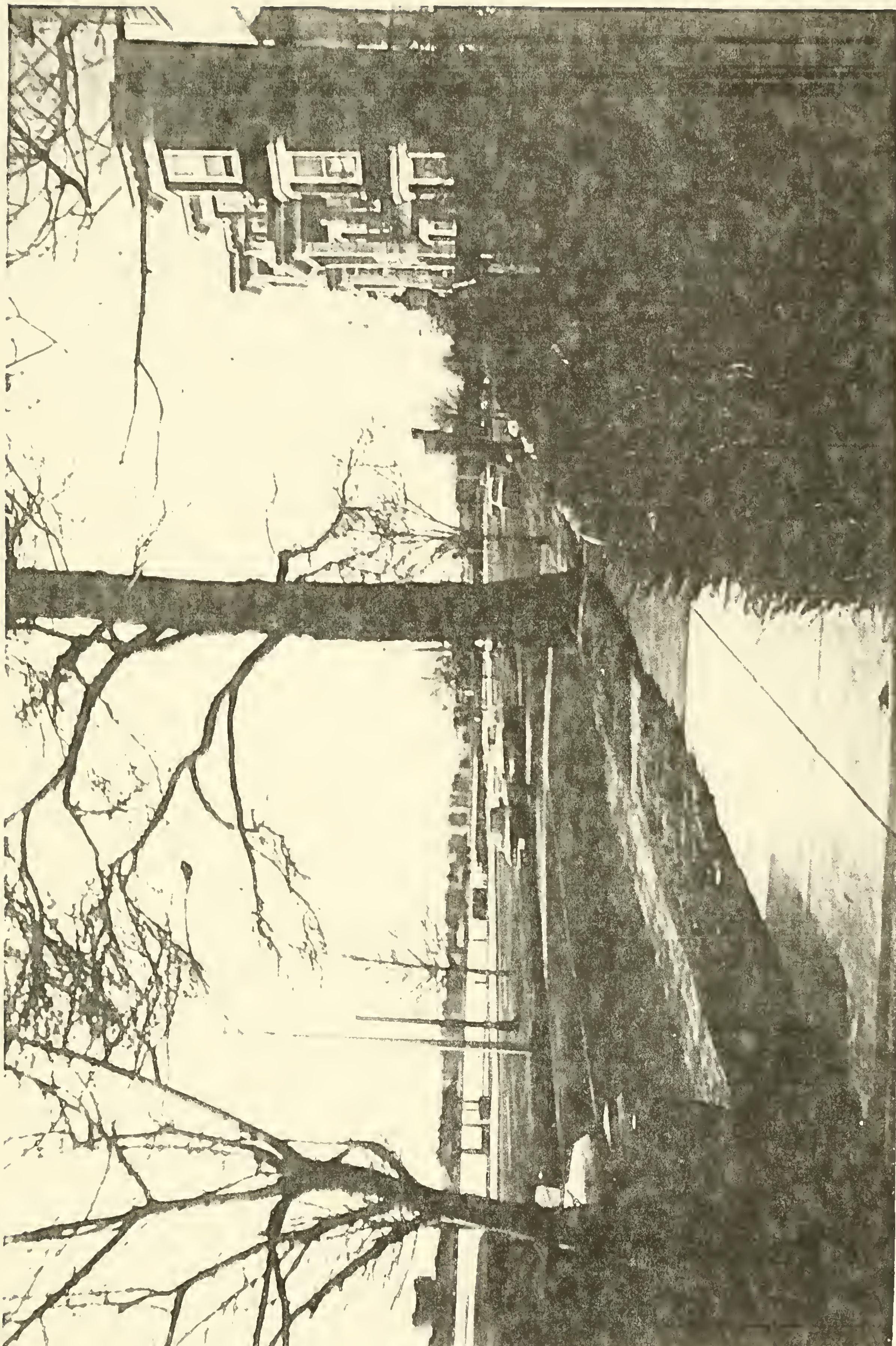
Dimension: 37'




D
CHARLES RIVER
looking east near
the Mass. Avenue
Bridge,
Boston
Dimension: 44'




E
BOSTON HARBOR
looking southwest
near City Point Beach
along Wm. J. Day
Boulevard,
South Boston
Dimension: 55'



APPENDIX R

QUALITATIVE ASSESSMENT OF THE WIND EFFECTS OF HARBOR POINT

APPENDIX S

FUTURE DEVELOPMENT ON THE COLUMBIA POINT PENINSULA

FUTURE DEVELOPMENT ON COLUMBIA PENINSULA

Purpose: This appendix provides data on existing conditions and probable impacts of proposed and potential developments on the Columbia Point Peninsula in addition to Harbor Point. The purpose of this appendix is to allow review of the individual and combined impacts of all potential development at Columbia Point within one document. Table 1 in this EIR identifies these parcels.

A. DESCRIPTION OF PROPOSED & POTENTIAL DEVELOPMENTS

1. Bayside Exposition Center - The proposed expansion of the Bayside Center calls for new construction of 150,000 square feet of office space in six floors with 25,000 square feet of ground floor retail space. The site of the new building is an existing paved parking lot along Mt. Vernon Street. The project also provides for a net addition of 350 surface parking spaces (and a waterfront park strip). Construction is scheduled to begin in spring 1986.

2. JFK Library - The JFK Library has proposed construction of a 21,000 square feet addition to the library and development of a pier on Dorchester Bay to accommodate tour boats and the Mass. research vessel.

3. Calf Pasture Pumping Station - No definite proposals have been made for development of the Calf Pasture Pumping Station but it has long been contemplated that the building might be converted into a public or quasi-public, multi-use facility. Any change in use would require approval of the Boston Water and Sewer Commission and might involve the transfer of the property to another entity for development.

   Development options for the building and adjacent land may include:

   - Continued use as a pumping station
   - Conversion to Restaurant & Retail Space (up to 75,000 s.f.)
   - Visitor Center/Community Center/Conference Center (40,000 s.f.)
   - UMass Student Center (40 - 80,000 s.f.)
   - Recreation Facilities
   - Urban Wilds

4. UMASS Parcel

The property between the JFK Library and the Pumping Station is owned by the University of Massachusetts and will be developed by the university according to its needs and capabilities. Potential development options include a student center, recreation facilities, or lab or other classroom facilities, but there are no definite plans or schedules for development.

5. McCormack Middle School/St. Christopher's Church - Use of portions of these parcels as active recreation space is being analyzed by BRA, Parks Department and other planning agencies.

6. Remaining Parcels - Most of the remaining land on Columbia Point is controlled either by the University of Massachusetts or the Boston College High School . There are no other known sites available for development on the Peninsula.

TABLE 1

Summary of Proposed and Potential Development

Bayside Exposition Center

Proposed Development: 150,000 s.f. office
25,000 s.f. retail
350 new surface parking spaces

Developer: Corcoran, Mullins, Jennison, Inc.
O'Connell Construction Co.

Timetable: Construction start- Spring 1986

JFK Library

Proposed Development: Proposed 21,000 s.f. addition to library
New pier to accommodate tour boats
and UMASS research vessel

Timetable: Still in planning stages

Calf Pasture Pumping Station

Existing Condition: 40,000 s.f. building (approx.)

Potential Uses: Continued use as pumping station
Restaurant retail (40,000 to 90,000 s.f.)
Visitor center/Community center/Conference center (40-80,000 s.f.)
UMASS conference center/student center (40,000 s.f.)
Active recreation facilities on current unused portion.
Urban wilds 200-room hotel.

U-Mass Parcel

Existing condition: Vacant

Potential Use: Educational Facility (lab, classroom)

McCormack Middle School/St. Christopher's Church

Potential Use: Active recreation space

Developing Agency: Boston Redevelopment Authority

B. LAND USE & DEVELOPMENT

The existing land uses at Columbia Point, described in detail in Part VB.1, include residential, commercial and institutional uses. The sites for potential future development are currently used for commercial use (Bayside Exposition Center), institutional (University of Massachusetts), public services (Calf Pasture Pumping Station) or are undeveloped. Most potential development would be related to the existing land use. Exceptions being reuse of the pumping station into restaurant use or hotel or recreation space development on the St. Christopher's parcel. These uses relate to the the new Harbor Point residential development.

1. Bayside - New office and retail construction at Bayside would be consistent with the existing commercial uses at the site. Impacts of the proposed development would be (1) increased intensity of use of site, (2) provision of retail space serving new Harbor Point residential community, (3) a net increase of 350 parking spaces at the site, (4) creation of recreation space linking existing Carson Beach and new Harbor Point recreation areas.

2. Pumping Station - Future development of this parcel will probably involve a change in land use and possibly a change from public ownership to private or quasi-public use.

3. McCormack/St. Christopher's - Future development of this site may involve a change in use of outside Macadam area to public recreation space.

4. Future Development on other parcels at Colùmbia Point will probably not involve change from existing land use.

C. TRANSPORTATION

1. Street & Highway Network:

   Potential development sites at Columbia Point are accessible primarily by Mount Vernon Street from Day Boulevard, and Morrissey Boulevard and by the U-Mass road off Morrissey Boulevard. Impacts of potential developments are included within the traffic analysis is Part VI.C:

   a. Bayside:

      The traffic analysis contained in Part VI.C. assumed development at Bayside in developing the 1990 traffic network. Several of the street improvements planned for Columbia Point described in Part VI will mitigate any adverse impact of new development at Bayside.

These include the following (described in detail on pp. VI-43-7)

- Day Boulevard Connector
- Mt. Vernon Street Reconstruction
- Southeast Expressway Reconstruction
- Central Artery/Third Tunnel Crossing
- Water Transportation

b. Calf Pasture Pumping Station

The BRA assumed a 200 room hotel, or similar structure at the pumping station.

c. JFK Library - According to Part VI, proposed development will not generate a significant number of new trips.

2. Public Transportation:

a. Bayside - A significant number of new employees commuting to Bayside IV may be absorbed by the rebuilt UMASS/JFK Red Line MBTA station. The addition of the Braintree Red Line branch to the station will allow direct commuting from the South Shore and will double service from the west. The Bayside Center will continue to be served by the 08 MBTA bus line.

b. JFK - Construction of the pier will add limited water transportation service to the entire peninsula.

c. Pumping Station - Currently, MBTA buses serving the existing Columbia Point project use Mt. Vernon Street. This route will also serve Harbor Point in the future, and could be expanded to serve new facilities at the pumping station.

d. McCormack School/St. Christopher's Parcel - New development would be served by existing bus service which is routed along Mt. Vernon Street.

e. UMASS - The UMASS shuttle bus from the MBTA's JFK/UMASS station will continue to serve the campus.

3. PARKING

Existing parking facilities at Columbia Point are adequate to meet current demand. Future development will require additional parking facilities based on the type of developments involved.

a. Bayside - Future parking demand at Bayside will be met

by utilization of existing facilities and through the acquisition of adjacent parcels along Mt. Vernon Street and behind the Expo Center. Access to these parking facilities will be improved as discussed in Section VI of the EIR.

b. Pumping Station - There is adequate space for additional parking if necessary.

c. UMASS - Future expansion by the University could be served by existing parking facilities or new sites.

d. JFK Library, McCormack Street - Potential developments at these sites would not generate significant demand for additional parking.

4. PEDESTRIAN TRAFFIC:

Potential future developments would generally not create substantial foot traffic. Primary pedestrian flows would be at:

a. Bayside between the MBTA Red Line station and new Bayside project. The improvements for pedestrian circulation along Mt. Vernon Street described in Part VI (VI-48) will address the Bayside impact.

b. UMASS with major flow occurring between the existing and any new University buildings.

D. PUBLIC SERVICE & UTILITIES

1. Water:

Bayside - Bayside IV will utilize 14,400 gallons/day. Project will utilize existing water mains.

Pumping Station - The potential commercial reuses of this site would add between 3300 and 6200 gallons/day in water demand (based on 40,000 to 75,000 s.f. of development).

JFK & St. Christopher's Site - These potential development sites will not add significant new demand for water.

2. Sewer and Drainage:

Future developments at Columbia Point would utilize sewer lines described in the EIR.

Bayside - The project will generate 13,125 gallons per day of sanitary sewage, and will use existing lines.

Pumping Station - Since it is only speculation that redevelopment of this property might occur, the gallons per day of sanitary sewage required under commercial reuse can only be estimated. Based upon the assumptions in C.3 above, commercial reuse of this site would result in between 3000 and 5600 gallons per day.

McCormack School Site, JFK Library - Potential development on these sites does not involve significant generation of additional sewage.

3. Solid Waste:

Bayside - The Bayside IV development will generate approximately .9 tons per day of solid waste.

Pumping Station - Commercial reuse of this site would add to tons per day of solid waste.

McCormack School Site - Potential development on these sites does not involve significant additional solid waste.

E. PHYSIOGRAPHIC IMPACT

1. Topography:

Future development is unlikely to change the existing, relatively level topography. Potential changes to shoreline possible in future as part of regional park system (rip-rap).

JFK - Shoreline changes with new pier.

Waterfront - Development of the waterfront park at Harbor Point will be coordinated with shoreline improvements on adjacent waterfront parcels. Potential development sites along the waterfront will be related to the new waterfront park by local and state regulatory commissions.

2. Soil:

As discussed in Part V (V-26-7) and Part VI (III-53), the soil at Columbia Point has low bearing capacity and will probably require driving piles to support new structures. Each new development will require site-specific study. Additionally, as filled tideland, Columbia Point parcels will require 21E for hazardous waste.

3. Groundwater:

As described in Part VI Section E.

4. Tidelands

No new filling of Dorchester Bay will be required for any of the potential development projects. Minor filling may be required for streetline improvements. Potential developments will require a Chapter 91 waterways license for developments on filled tideland if the development is not water dependent.

a. Bayside - The proposed office/retail construction is not a water dependent use, but as a part of the overall plan for the Dorchester Bay waterfront, Bayside IV should have a positive impact on the Dorchester Bay tidelands. The site of the Bayside IV building - along Mount Vernon Street - is away from the waterfront, on the opposite side of the Exposition Center from Dorchester Bay. Bayside IV will provide a waterfront park strip allowing public access between the new Harbor Point park and Mother's Rest at Carson Beach.

Bayside IV serves a proper public purpose as part of the publically-sponsored effort to revitalize the Columbia Point peninsula. The proposed project is a continuation of the program to revive the vacant former Bayside Mall site into active retail, office and exposition space complementing the residential and commercial community at Columbia Point. Ground floor retail space will serve the needs of the residents of the Harbor Point community. Secondary effects of the project which serve a public purpose include: increased local tax revenue and generation of jobs; physical improvement of the waterfront; replacement of underdeveloped and underutilized land with active uses and landscaping improvements.

F. WATER QUALITY & FLOODING

1. Water Quality:

The existing water quality at Columbia Point is discussed in Part V. The potential developments examined here would not generate impacts different from those described for Harbor Point in Part VI.

2. Flood Potential:

All structures in potential development sites lie outside Zone A3, the 100-year flood area.

Bayside - The rear parcel to be used for parking and park strip lies partially below 100-year flood mark. No structures will be built on this parcel.

JFK - The new pier development is within the flood zone. The Army Corps of Engineers will prepare a separate environmental study for this site.

G. VEGETATION AND BIOLOGY

Native vegetation and wildlife on the peninsula is described in Part V (V 30-33). Potential future development sites are either paved or sparsely vegetated.

Bayside - Development of this site will replace some paved or barren ground with landscaping improvements.

McCormack/St. Christopher's Parcel - A new park on this site would replace existing vegetation and areas with landscaping improvements.

H. AIR QUALITY

Existing air quality conditions at Columbia Point are described in Part V. As with Harbor Point, the primary impact on air quality from potential developments is the generation of new traffic. The results of new traaffic generation can be found in Part VI.H and Appendix L.

I. NOISE LEVELS

As noted in Part VI, the primary impacts on noise levels in the future arise from airplane noise and traffic.

The maximum noise levels from traffic that would result from potential future development would be dB.

J. URBAN QUALITY

The proposed and potential developments are consistent with public plans for reestablishing a positive urban environment at Columbia Point. For several years, the quality of urban life on the peninsula has suffered from abandoned residential units, the failed Bayside Mall, and vacant parcels with no clear owner or purpose. The existing underutilized land can support additional development in the future, particularly development that clarifies ownership and use of vacant parcels, and fills in gaps between the peninsula's major residents. Given the varied nature of the anchor residents - Harbor Point, Bayside, UMASS, BC High - the maximum positive effect on the urban quality of Columbia Point will be achieved through a program of future development which balances residential, commercial, and institutional uses.

Bayside - The proposed Bayside IV development will improve the urban environment at Columbia Point by providing a "hard edge"

along Mt. Vernon Street, the major route into the new Harbor Point community, and by replacing underutilized parking spaces and barren ground with landscaping improvements. New retail space will contribute to the new residential community at Harbor Point.

Calf Pasture Pumping Station, U-Mass Parcel - Future development on these sites is proposed to provide active uses of the vacant land between Harbor Point and the JFK library.

APPENDIX T

RELOCATION GUARANTEES

HOUSING OPPORTUNITIES UNLIMITED
320 Mt. Vernon Street Dorchester, Massachusetts 02125 (617)288-4569/288-5624

PERMANENT RELOCATION PLAN

Submitted by:

David I. Connelly
Housing Opportunities Unlimited
Revised September 26, 1985

Table of Contents

INTRODUCTION:

A. Statement on Scope of Work

Since December 1983, HOUSING OPPORTUNITIES UNLIMITED has been developing drafts of relocation strategies for the Columbia Point/ Harbor Point community. These strategies have focused both on temporary and permanent relocation. In effect, the temporary relocation of some 35 Columbia Point residents has already been completed. Please see section II for more details. These temporary relocation moves were based on an overall plan for the site that covered the needs of all principals involved.

Our process for developing these plans began with carefully studying the overall site itself as well as the preliminary architectural renderings and construction scheduling. The needs of the principals involved in the redevelopment were considered in the plan and they participated in a coordinated research effort. These principals include: the residents of Columbia Point and their elected representatives the Columbia Point Community Task Force; the Peninsula Partnership; Vernon Construction Company; the marketing teams; CMJ Management; as well as federal,state and city agencies.

Once the needs of the community were determined and logged, schedules, concerns,budget constraints, timetables, opinions and guidelines were coordinated into a feasible plan. Given the complexity of this redevelopment project, adaptations to the original plans of December 1983 have been the norm. These adaptations were influenced by government regulations, changing population needs, as well as revised marketing and construction priorities.

The relocation plan found herein, is an outline of a more detailed and forthcoming final plan. The final plan will contain timelines, specific schedules, architectural renderings, construction phasing, marketing strategies and a final statement on unit mix and highest population density of current Columbia Point families.

Sources for this plan include:

A. HUD Guidelines (Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 P.L. 91-646).

B. State Relocation Assistance Regulations pursuant to Chapter 79A and 121A.

C. Updated architectural drawings from Goody, Clancy and Associates and from Mintz Associates Architects.

D. Chapter 760 CMR 27.00 State Relocation Assistance Regulations.

E. Current BHA Columbia Point Tenant List and results of Resident Survey conducted by Housing Opportunities Unlimited.

F. Updates from meetings with the general development team and its Resident Service/Relocation Subcommittee.

We realize that, at times, the needs of management, marketing and construction may differ from those of the residents. However, it is anticipated that the final relocation plan, with input from all the partners will be an amalgamation of those varied needs and will do justice to all the parties.

B. PREMISES:

Given the requirements of the Task Force, Management, Construction, and Marketing, the premises listed on the next page have been considered in each part of the relocation plan and its subsequent programming. The premises are characterized by the belief that the needs and comforts of the residents will always be given top priority. To make this happen, a policy decision to minimize the number of temporary moves for current residents was agreed upon.

The Premises are:

1. Every current Columbia Point resident will have the option to remain on site during and after construction and will be encouraged to do so.

2. Every effort will be made to relocate the fewest number of residents the least number of times.

3. Residents will be kept as comfortable as possible during the transition. A Resident Service Program will work in tandem with the Relocation Plan to assure this occurs.

4. Residents will be advised of their rights during the transition and will be ensured that they receive all the benefits due them.

5. An equal distribution of current Columbia Point residents will be maintained throughout the development in a proportionate ratio in order to create a truly mixed environment.

6. Open lines of communication will be maintained between Housing Opportunities Unlimited, the residents, and the Columbia Point Community Task Force. It will be H.O.U's responsibility to keep the community informed of the latest architectural and managerial plans.

II. TEMPORARY RELOCATION:

A. Plan

Prior to physically moving any of the families, the following steps first occured:

1. The overall construction phasing was reasonable determined.
2. The total number of families in need of temporary relocation and their bedroom needs were calculated.
3. Decisions were made as to which buildings were to be vacated and in which order.
4. HOU staff coordinated this effort with management in order to locate appropriate vacant units on site so that they could be rehabbed and prepared for occupancy.
5. Work schedules were coordinated with the utility companies and arrangements were made for transfer of services.
6. Appropriate forms were prepared for signatures based on federal, state and local guidelines.

B. Specific Actions

The plan for temporary relocation called for the relocation of 36 families and two (2) existing on-site agencies, with the intent of emptying out three buildings (#18,20,26), which are scheduled to be part of the Phase I construction activity. 30-day notices were given to 36 households in the month of November. These residents were informed at that time of the relocation process, the benefits due them, and a tentative date for their relocations. In a few cases in which apartments were ready early, residents also signed a waiver, stating that they would be willing to move within 30 days. HOU workers met personally with each of the 36 heads of households, either in his/her own home, or in the office, in order to assure that the residents were prepared for their move.

Sixteen families were relocated from Bldg. #18 (5 Belvoir), nine families were relocated from Bldg. #20 (174 Monticello), and one family was relocated from Bldg. #13 (15 Brandon). The purpose in emptying buildings #18 and #20 was to move residents out of the Phase I construction area to consolidate residents in as few buildings as possible in Phases II and III. Building #18 is scheduled to be rehabbed and turned into the elderly building; Building #20 is scheduled to be demolished. Both buildings are part of the Phase I construction schedule. In addition to the 36 families that were to be relocated, three existing on-site agencies had to be relocated from Bldg. #26, which is also scheduled to be demolished in Phase I construction.

C. Outcomes

Altogether, then, the 36 family relocations and the two agency relocations (actually only two agencies were relocated on-site, the third decided to move off-site) have emptied out three additional buildings (Bldg. #18, 20 and 26) and brings the total # of vacant buildings on site to 16, and the total number of buildings occupied by residetns or agencies remains at 12.

TEMPORARY RELOCATION - Continued

7. Moving companies were interviewed and selected on the basis of quality, cost, and availability. A tenant moving company was selected.

8. Arrangements were made with residents to choose between self-moves, movers etc. and dates for these moves were coordinated.

9. The appropriateness of available units were determined in regards to vacancies in the elderly building, floor, elevator availability.

10. A procedure for grievances was addressed.

Once the temporary move plans were approved, the process for the physical moves were put in place. Dates for the moves were mutually agreed upon, schedules were coordinated with Management, which in turn arranged for subcontracting to elevator companies in order for the elevators to be functioning for the moves. In addition, the movers, utility companies coincided their schedules with these dates.

HOU received approval for appropriate documents from involved agencies regarding the moves and filled out and filed these documents accordingly. Record keeping is an important aspect of this area which includes arrangements for reimbursement to residents, paying moving costs and assuring that this was done in a timely manner. In addition to the families being temporarily relocated because of building demolition and construction, another small group was relocated because of building deterioration, medical necessities, safety hazards and small children living on upper floors of buildings with non-functioning elevators. Five (5) families were moved to vacancies in the elderly building and on-site agencies involved with the care of the elderly were notified.

D. New Location of Residents

The residents and agencies who were relocated were moved into the following buildings:

5 elderly	-	Moved into Bldg. 27
15 families	-	Moved into Bldg. 13
11 families	-	Moved into Bldg. 25
2 families	-	Moved into Bldg. 10.
1 family	-	Moved into Bldg. 4
1 family	-	Moved into Bldg. 16
1 family	-	Moved into Bldg. 14
2 agencies	-	Moved into Bldg. 22

In keeping with our stated residents services goal of community involvement, we were very interested in employing the services of the moving company that had been organized by some residents for the purpose of carrying out temporary relocations. After interviewing a number of professional outside moving companies, we found that the Tenants' Moving Company not only had competitive prices and equally good insurance coverage, but was also genuinely interested in helping the other residents make their relocations as painless as possible. The Tenants' Moving Company was hired, and was successfully used in 40% of the relocation moves. The remaining 60% chose to receive their relocation benefit payment of $250 to move themselves.

The relocations themselves took place over a period of three and one half months, from November 20, 1984 until March 4, 1985. Building #18 was emptied first, and closed up on February 4th. Building #20 was emptied and closed up on March 4. The two agencies were then relocated from Bldg. #26 during the middle week of March. The actual relocation process went relatively smoothly. The main problem was that the elevators were not functioning in any of the buildings involved in the Relocations, except for the elevator in the elderly building (Bldg. #27).

New Location of Residents - Continued

For that reason, each relocation move from or to any floor above the third required the presence of a CMJ contracted elevator man to manually run the elevator during the move. This was a slow process and it was often impossible to schedule two relocation moves in the same day - especially if two people were moving out or into the same building. Having working elevators should make the permanent relocation process go a lot more smoothly and quite a bit faster.

III. SURVEYING RESIDENTS

A. Process

In order to determine the demographics of the Columbia Point population, a comprehensive survey was drawn up that helped us to analyze the composition of the residents. This survey worked in other ways as well. It was the first introduction of the relocation staff to the population at large and the population's first introduction to the relocation plan. Staff was trained in advance and emphasis was placed on their being sensitive to the needs of the residents and to protect their privacy of reply. The survey was presented in such a way to the residents as to gain their confidence, trust and at the same time give them the information they would need regarding the future changes in their community. Staff was hired to meet on a one to one basis with each head of household, to send letters, make calls and track down those reluctant to respond. Finally, it was necessary to compile the survey results and analyze them in terms of family size and future bedroom needs. This information which was first drawn in the Summer of 1984 and later updated in the Spring of 1985 served to influence the architects and designers in their design of buildings and unit sizes so that the existing Columbia Point population would be housed according to their needs.

B. Results

Families will continue to grow and bedroom needs will adapt accordingly. Any population loss will be a factor of natural attrition, eviction or families wanting to move off site because of the construction factor.

Special attention will of course be given to the handicapped. The elderly will have their own block of buildings in the new development complete with means to service their needs. Requirements for elderly living will soon be forthcoming but will include over 55, no children, and no units larger than a two bedroom will be included in the block.

Pertinent to the subject of relocation, HOUSING OPPORTUNITIES UNLIMITED will also be involved w setting up programs for all age levels to deal with the changes that will occur in the new community. Special attention will be given to Youth and the Elderly. This includes: site safety, dealing with construction, learning about and accessing to new jobs and careers as a result of on-site activity; coping with a changing enviroment which would include overcoming fear of change; orienting to the ocean; changing traffic patterns, child safety etc.

A study of family needs was put in place and division of some larger families into "subset families" occured. These "families within families" consisted of when a son or a daugther continue to live with their parents while they have a family of their own. Specifically subset families had to have their first child born prior to October 1, 1984 and had to have been on their parents lease. These subset families are entitled to their own units and to enjoy the same rights as other head of households in the new community.

C. Present Population

The population of Columbia Point at this time is relatively stable. As of July 1, 1985 there are 1263 residents of Columbia Point living in 364 families. This number 364 includes the 43 subset families discussed in the previous section. According to our statistics of (date) the cultural mix at Columbia Point is:

Black families	248	Population size	78%
Hispanic families	54	Population size	17%
White	10		3%
Other	8		2%

When Interim Management took over from the BHA on October 1, 1984, new families ceased to be admitted to the development. Although the Columbia Point population changes weekly, no new families would need to be oriented to the Columbia Point Resident Service Plan or to fill out survey or relocation data. Of course, the population may decrease because of natural attrition, eviction or preference by a family to move off site during construction. Although one of the premises listed in the introduction clearly states our desire to have all residents currently on-site throughout the redevelopment, we recognize that some families may prefer to leave (because of health or other reasons). Arrangements will be made individually to help them relocate outside the community.

IV. REHOUSING GUARANTEE

Once the temporary relocation got underway and the survey results were compiled, the next tactic was to deliver the Rehousing Guarantees to the head of each household. This guarantee assures Columbia Point families of receiving a unit in the redevelopment. (see attached exhibit) To make this come about, careful scrutiny of the BHA TSR (Tenant Status Review) occured in coordination with Management. Again trained staff introduced the Rehousing Guarantee to the heads of households and worked carefully with them to make sure that they understood clearly the terms of the agreement before signing. A Resident Services package was designed by Housing Opportunities Unlimited staff (see exhibit) that illustrated the changes that have already occured in the redevelopment, those that will occur as well as describing groups and people involved. The package also contains letters from the Columbia Point Community Task Force and another needs assessment to update the Resident Survey from the summer before. This served to get all the pieces in place for the next major step---the Implementation of the permanent relocation plan.

V. UNIT MIX

The following premises formed the foundations upon which we based our unit mix strategy:

1. All areas of the site are to be integrated as much as possible both economically and racially.

2. All current Columbia Point residents are to be integrated with new residents throughout the site assuring that clusters of current Columbia Point residents do not result.

3. All elderly residents of Columbia Point are eligible for units in the elderly complex, if they so desire;

4. All households with children over 18 are eligible for a unit in the elevator buildings;

5. All households with children under 18 are to be placed in Ground Access (GA) Units, per directives from the Columbia Point Community Task Force, the CMJ Developers, and official HUD (Section 9) Guidelines.

6. All units on Mt. Vernon Street should have a cross-section of residents. This is especially important because many of the larger units are located in this area and many current Columbia Point families are of the size suitable to occupy the units.

The first step in determining a realistic Unit Mix was to calculate the existing bedroom needs of families currently residing at Columbia Point. This number also had to take into account the number of subset families who would be eligible for their own apartments. In order to calculate bedroom needs, we utilized the results of the Resident Survey which was carried out in 1984. Unfortunately, the survey is fast becoming outdated, as the population at Columbia Point, although relatively stable, does change on a weekly basis. Existing bedroom needs were again assessed by HOUSING OPPORTUNITIES UNLIMITED in June, 1985. In September 1985 a study of the Tenant Status Review was done by Housing Opportunities Unlimited with cooperation from CMJ Management. This TSR study indicated that more residents were eligible for non-ground access units than initially anticipated. Given existing bedroom needs, we could then begin to plan where possible unit mix-integrating Columbia Point residents throughout all the blocks of the site.

Taking one block at a time, we then calculated the percentage of Units/Blocks to be occupied by Columbia Point families. We also calculated the percentage of residents per block so that the Unit Mix could also be seen in terms of population density. Working and reworking the numbers for the Unit Mix, we finally came up with what we feel is the best possible Unit Mix--one that follows the premises upon which we began to study the whole Unit Mix question.

This process was aided by the changes in the site plan which called for 120 less units in the total figure and 27 additional ground access units. The new site plan includes 6 new mall buildings with increased ground access units and the deletion of two stepped mid-rises and two mid-rises that did not have ground access units. The complete integration of the site economically becomes a greater reality. Also, with the additional numbers of non-ground access units which was determined from the TSR study, the block by block percentages of Columbia Point units now lie more equitably across the site.

There has been some discussion as to whether or not the larger units will be rented in the "market" category in the future. This would considerably improve the Unit Mix in the town house blocks and would integrate the elevator buildings more evenly. This decision, however, would certainly raise other important issues such as wheterh or not the Section 8 subsidies ought to be continued to be used for large families. Integration would be achieved but a subsidy would be lost for a large family.

The current Unit Mix is broken down by blocks in terms of the percentages of Units occupied by Columbia Point families per block. Obviously the mall blocks will have the lowest percentage as fewer Columbia Point households have children over 18. Blocks that have town houses side by side mall buildings also have relatively

low percentages of Columbia Point units becuase the mall buildings contain many apartments on the upper floors. It is in the blocks made up of only townhouses or rehabbed buildings where the percentage of Columbia Point units is slightly higher. Given the stated premises, the Unit Mix chart below is as accurate as is possible with the changes.

COMPARISON OF COLUMBIA POINT ORIGINAL AND REVISED UNIT MIX PLAN

Block #	Original/Revised Total Units	Original/Revised Columbia Point Units	Original/Revised % Columbia Point Units
1	99/78	13/21	13%/27%
2/3	36/35	22/13	62%/37%
4	12/12	8/4	66%/33%
5	184/144	9/22	4%/15%
7	184/144	10/22	5%/15%
8	42/42	27/16	64%/38%
9	93/74	12/16	12%/22%
10	66/66	22/21	33%/32%
11	66/66	24/20	36%/30%
12	68/68	24/23	35%/34%
13	26/26	17/10	61%/38%
14	46/46	17/18	36%/39%
15	152/153	6/27	3%/18%
16	27/27	14/9	51%/33%
17	27/27	14/9	51%/33%
18	90/90	42/41	46%/45%
19	39/39	8/8	20%/21%
20	32/32	16/12	50%/38%
21	53/53	26/20	50%/38%
22	60/60	34/23	56%/38%

*No Block other then the elderly Block (18) exceeds 39% or has less then 15% Columbia Point Units.

As a result of the placement of Columbia Point residents listed previously, we have achieved certain percentages by Block that we feel equitably distributes residetns throughout the site. This takes into consideration the constraints of construction needs and the requiremetn of the Task Force and the Peninsula Partners that no families with small children be placed in elevator buildints above the first floor. It is the belief of Housing Opportunities Unlimited and the Task Force that, in general, these numbers will diminish over time as will the percentage of Columbia Point families per block.

VI. PERMANENT RELOCATION PLAN

Until this Section, discussion centered on planning the overall relocation strategy and implementing the Temporary Relocation Plan. Special emphasis has been placed on gathering date about family size and needs pertinent to permanent relocation planning. All of this data is recorded in Housing Opportunities Unlimited files and the numberical information has been cross-referenced with that of CMJ Management and the Boston Housing Authority through the Tenant Status Review (TSR).

To assure quality record keeping, Housing Opportunities Unlimited will begin the computerization of this information. Computerization will allow us to have constant up to date files, reflecting the changing needs of the Columbia Point population and will allow us to respond to those needs expediently.

Relocation will begin approximately 14 to 16 months after construction starts. When the first units are ready for occupancy they will be a combination of all building types on site. This grouping of new townhouses, rehabbed low-rise and mall buildings, should create a smaller version of the new community, and allow for mixed racial and economic development at the beginning of relocation.

PERMANENT RELOCATION PLAN

Below is a listing of the buildings currently occupied in the order in which they are to be emptied out. Below each building is a breakdown of existing tenants of that building by bedroom size (Bedroom size is based upon current need). Opposite the list of bedroom sizes needed, are the units in the new development where the current families will be relocated to. This permanent location plan was formed with the construction schedule in mind. When describing where a family is to be relocated, we used the numbers which indicate Block#-Building#; for example, a family being relocated into "15-2" from Building 13, would mean that that family would be moving to Block 15, Building 2. The number in parentheses following a number is the number of units being occupied by Columbia Point residents.

Attached please find a list of Current Bedroom Needs Based on Projected construction scheduling of Columbia Point Residents. The buildings are listed in the order that they will be vacated.

We have also listed the number of family units (Ground Access) available to non-Columbia Point families. Attached also find a detailed listing of each building, and where the current residents will be relocated. A construction schedule has been received which indicates the times when buildings will be ready for occupancy. The relocation plan follows this construction schedule.

Available Family Units for non-Columbia Point Families

2BR (Ground Access	77
3BR	60
4BR	11
5BR	4
Total	152

Current Bedroom Needs Based on Projected Construction Schedule

(Buildings are in the order in which they will be emptied out)

Building #	1BR(T)	2BR(T)	2BR(GA)	3BR(GA)	4BR(GA)	5BR(GA)	6BR(GA)	Elderly	TOTAL
1. BLDG 4	1	9	5	13	12	1			41
2. BLDG 27								33	33
3. BLDG 9		1	5	19	12	1	2		40
4. BLDG 14	1	7	3	8	8	1			28
5. BLDG 15	2	4	5	12	3	1	1		28
6. BLDG 10		2	4	9	3				18
7. BLDG 19	2	2	9	10	4	1		2	31
8. BLDG 16	3	5	9	10	4	2		2	35
9. BLDG 13	3	4	22	30	3	1	1	4	68
10. BLDG 25	5	9	16	5					35
Total BR Needs	17	43	78	116	49	8	4	41	356 Units Needed

PERMANENT RELOCATION PLAN

Building #4 (340,350 & 360 Mt. Vernon Street) — Total Units 41

Bedroom Needs:	Relocated to:
1 - 1BR	1-1
9 - 2BR (T)	1-1(4), 5-1(3), 5-2(2)
5 - 2BR (GA)	4(4), 2-1(1)
13 - 3BR (GA)	1-1(2), 1-2(3),22-1(3), 22-2(1), 21-2(4)
12 - 4BR (GA)	1-2(1), 16(5), 22-1(5), 22-2(1)
1 - 5BR (GA)	22-1

Building #27 (176,180 & 184 Monticello Avenue) — Total Units 33

Bedroom Needs:	Relocated to:
24 - 1BR	18-1(24)
9 - 2BR	18-1(9)

Building #13 (11,15 & 19 Brandon Avenue) — Total Units 68

Bedroom Needs:	Relocated to:
3 - 1BR (T)	1-1(1), 5-1(2)
4 - 2BR (T)	5-1(4)
22 - 2BR (GA)	5-1(4), 5-2(4), 1-1(7), 1-2(1), 14-1(4) 15-2(2)
30 - 3BR (GA)	2-2(2), 3-1(2), 3-2(4), 3-3(3), 14-1(2) 14-2(4), 14-3(3), 14-4(2), 16(3), 21-1(5)
3 - 4BR	21-1(3)
1 - 5BR	21-1(1)
1 - 6BR	1-1(1)
4 - Elderly	18-1(4)

Building #9 (7,11 & 15 Montpelier Road) — Total Units 40

Bedroom Needs:	Relocated to:
1 - 2BR (T)	5-1(1)
5 - 2BR (GA)	14-1(4), 7-1(1)
19 - 3BR	12-2(4),12-4(3), 12-1(1), 17(4), 10-1(2), 12-3(5)
12 - 4BR	14-3(1), 14-4(1), 16(2), 17(5), 12-4(1), 12-3(1), 22-1(1)
1 - 5BR	14-3(1)
2 - 6BR	3-2(1),13-2(1)

Building #14 (50 & 60 Monticello Avenue) Total Units 28

Bedroom Needs:	Relocated to:
1 - 1BR	5-2(1)
7 - 2BR (T)	5-2(5), 5-1(2)
3 - 2BR (GA)	15-2(3)
8 - 3BR	13-4(2), 13-1(1), 13-2(2), 13-3(3)
8 - 4BR	21-2(4), 22-2(4)
1 - 5BR	13-3(1)

Building #15 (30 & 40 Monticello Avenue) Total Units 28

Bedroom Needs:	Relocated to:
2 - 1BR	5-2(1), 15-2(1)
4 - 2BR (T)	5-2(2), 15-2(2)
5 - 2BR (GA)	11-1(5)
12 - 3BR	11-1(2), 12-1(1),8-2(6),11-2(2),11-3(1)
3 - 4BR	19(3)
1 - 5BR	11-4(1)
1 - 6BR	8-2(1)

Building #10 (19 Montpelier Road) Total Units 18

Bedroom Needs:	Relocated to:
2 - 2BR (T)	15-2(2)
4 - 2BR (GA)	19-(2), 7-1(2)
9 - 3BR	22-4(4), 22-3(2), 22-5(2), 11-2(1)
3 - 4BR	21-2(3)

Building #19 (260 & 264 Mt. Vernon Street) Total Units 30

Bedroom Needs:	Relocated to:
2 - 1BR (T)	15-2(2)
2 - 2BR (T)	15-2(2)
9 - 2BR (GA)	15-2(2), 7-1(1), 7-2(4),10-1(2)
10 - 3BR	8-2(6), 11-2(2), 11-3(2)
4 - 4BR	11-3(1), 10-3(1), 20-1(2)
1 - 5BR	21-2(1)
2 - Elderly	18-2(2)

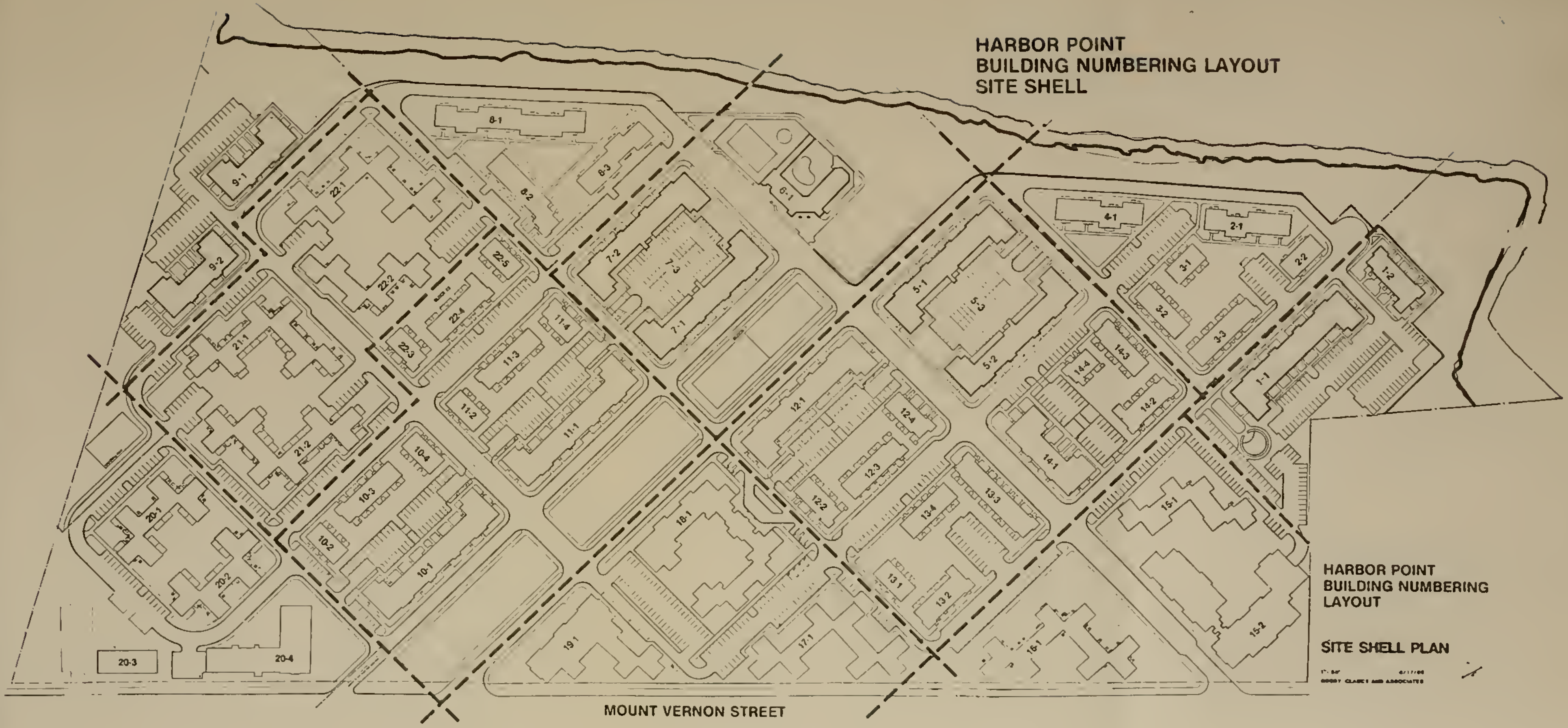
Building #25 (76,80 & 84 Monticello Avenue) Total Units 35

Bedroom Needs:	Relocated to:
5 - 1BR (T)	9-1(1), 15-3(4)
9 - 2BR (T)	9-1(2), 9-2(1), 15-3(3), 15-1(3)
16 - 2BR (GA)	8-3(2), 9-1(4), 9-2(4), 12-1(6)
5 - 3BR	20-1(1), 9-2(2), 9-1(2)

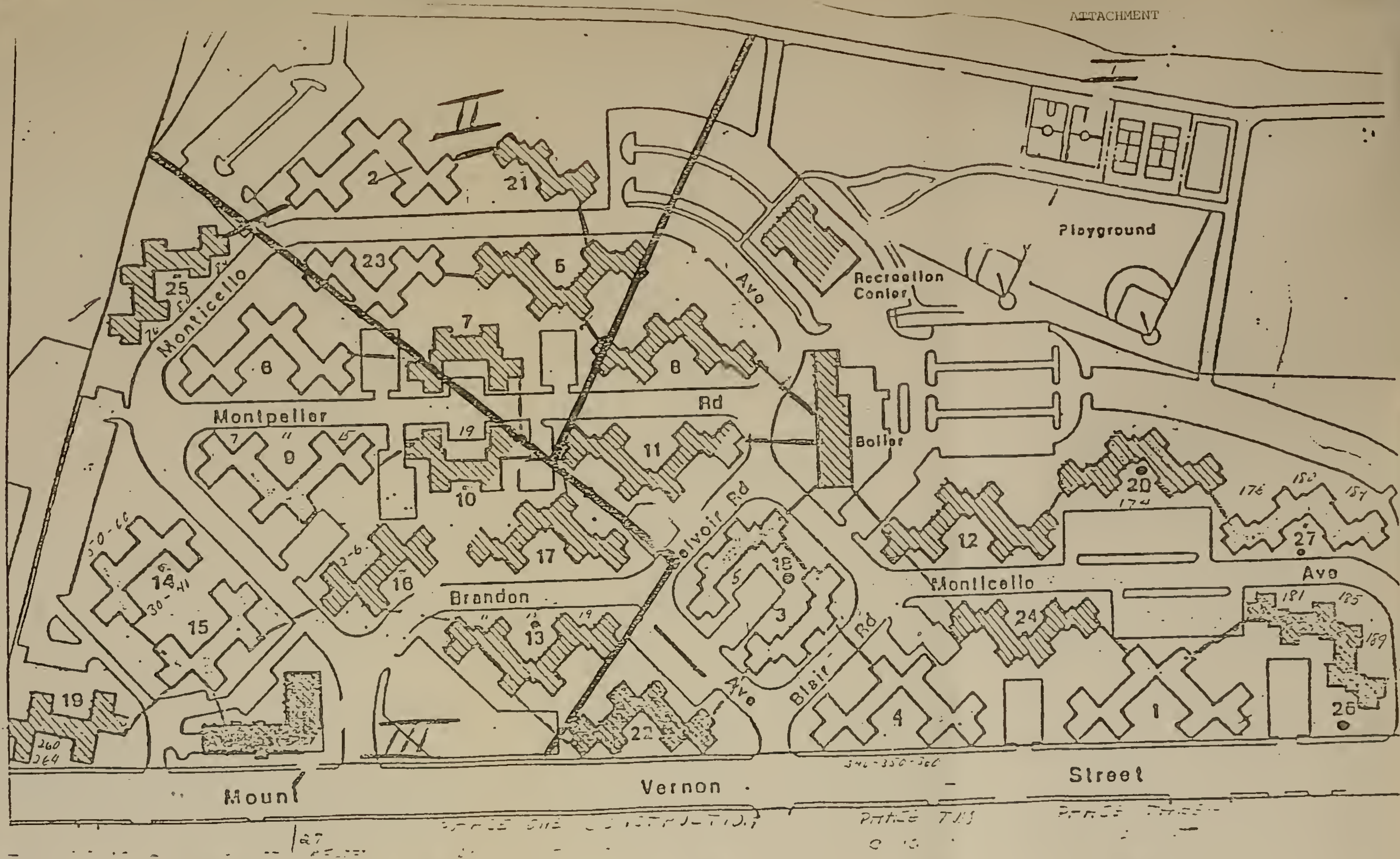
Building #16 (2 & 6 Brandon Avenue) Total Units 35

Bedroom Needs:	Relocated to:
3 - 1BR (T)	15-1(3)
5 - 2BR (T)	15-1(5)
9 - 2BR (GA)	10-1(3), 11-1(1), 8-1(4), 8-3(1)
10 - 3BR	10-3(5), 10-2(3), 20-2(2)
4 - 4BR	21-2(1), 21-1(2), 20-1(1)
2 - 5BR	22-3(1), 16(1)
2 - Elderly	18-2(2)

ATTACHMENT A



ATTACHMENT



II
Playground
Recreation Center
Boiler
Monticello
Montpelier
Rd
Ave
Belvoir Rd
Brandon
Blair Rd
Ave
Monticello
Ave
Mount
Vernon
Street

COLUMBIA
POINT
COMMUNITY TASK FORCE INC.

June 18, 1985

Dear Resident:

The Columbia Point Community Task FOrce takes great pride in presenting to you for your signature, your REHOUSING GUARANTEE.

Since the Columbia Point Community Task Force incorporated in 1978, many residents have actively served on its Board of Directors. It is the hard work of all the Boards, past and present, who have made this REHOUSING GUARANTEE A REALITY. And we thank you, the residents of Columbia Point, for all the time, patience and efforts you have given to secure a quality living environment for your family.

The Rehousing Guarantee signals the beginning of Harbor Point and your signature assures your family of a unit in the new community. Two copies of the Agreement are enclosed. Please sign them both and return one to the Outreach Worker presenting this package for the permanent file. The other copy is yours. It should be kept for future reference in the accompanying folder. Other background information about the Guarantee can be found on the page behind this letter. Please read it carefully before you sign or call the Task Force with any questions at 265-3034.

We hope you will take a few minutes with the Outreach Worker to go over the other materials in this folder. You will find important information about the changes that are happening in your community and drawings of what you can look forward to in the near future. In addition, the Outreach Worker will be asking you some questions. Answer those that you feel most comfortable with. These questions will help us to provide your family with the programs, activities, services and type of housing units that will best suit your needs.

Remember COLUMBIA POINT/HARBOR POINT is your community. We look forward to your active participation in your future.

Sincerely,

Esther Santos

Esther Santos, Clerk
Columbia Point Community Task Force

WHAT DOES THE REHOUSING GUARANTEE MEAN?

A) YOU HAVE A LEGAL RIGHT TO HAVE A NEW OR SUBSTANTIALLY REHABBED UNIT IN THE NEW HARBOR POINT APARTMENTS.

* No one is doing you a favor by "letting you live here." You have a legal right to live in the new development. This is your right as a current Columbia Point resident.

* In order to have this right, you family must remain in Columbia Point during construction, or move into a temporary apartment that has been approved by Management until your new apartment is ready.

* If you decide, for some reason, to leave Columbia Point, you can transfer this rehousing guarantee to another adult in your family, as long as he or she is listed on the TSR.

* The right to live in a unit in the new Harbor Point cannot be taken away from you, as long as you remain a resident of Columbia Point. In the case of eviction, you automatically give up this right. Eviction can occur from non-payment of rent or from breaking the rules set up by the Habor Point Apartment Company.

B) RELOCATION RIGHTS AND BENEFITS

* You'll be given a unit that is new or substantially rehabbed.

* You'll be given a unit that has the appropriate number of bedrooms for your family.

* In most cases, you'll only have to move one time.

* If you need to be temporarily relocated, you'll be given an apartment that's decent, safe and clean. The apartment will have appliances in good working order and and the number of bedrooms appropriate for your family.

* You'll be given a unit which takes into consideration any medical, employment, or special needs you may have.

* You'll be given adequate notice before you move, so you'll have time to prepare to relocate.

* You'll receive all the relocation benefits (cost of move, cost of moving telephone) that you are entitled to under law. Relocation costs are not your responsibility.

C) WHO SIGNS THIS AGREEMENT?

* You - This is your legal right as a Columbia Point Resident.

* The Columbia Point COmmunity Task Force - They will be part owners (along with the Peninsula Partners) of the new Harbor Point development.

* The Peninsula Partners - They'll be joint owners (along with the Task Force)of the new Harbor Point.

* CMJ Management - They are currently managing Columbia Point, and will be the management in the new Harbor Point as well.

* Boston Housing Authority(BHA) - They are the official owners of Columbia Point until all construction is finished.

YOUR COMMUNITY TASK FORCE WAS RESPONSIBLE FOR ASSURING YOU THIS REHOUSING GUARANTEE!

Support the Task Force by coming to the meetings on Monday evenings at 7:00 p.m. at the Task Force Office. Find out how you can help get involved in the decision making.

HOUSING OPPORTUNITIES UNLIMITED
Dorchester, Massachusetts

DATE:_______________ OUTREACH WORKER:______________________

Head of Subset Family:____

Address:____________________________________APT #________BOX#___________

Telephone:_____________________ Listed? YES____ NO_____

We are trying to better assist you through the redevelopment process. In order to do so we must ask you questions about your family with the hope of having a better, brighter, more enjoyable life here at Columbia Point. We want you to feel comfortable in sharing things with us knowing that what you tell me will only be for our knowledge and not that of the community. I need your trust as much as you need mine. Lets see what we can do for each other.

1. (WORK)

Is there anyone in your household that is now looking for employment or training?

____

____

____

____

2. (EDUCATION)

Is there anyone in your household interested in receiving educational assistance?

____

____

____

____

3. (FAMILY LIFE)

Is there anything going on in the family that we (HOU) can assist (help) you in?

Agency people involved with family:

Name	Agency	Phone

Plan:

When you will get back to resident:

This Rehousing Guaranty guarantees on behalf of the Boston Housing Authority ("BHA"), CMJ Management Company, Inc ("CMJ"), Peninsula Partners and the Columbia Point Community Task Force, Inc. that

(Name of Tenant)

(Street Address and Apartment)

Boston, Massachusetts

who is also called in the Rehousing Guaranty the "Tenant") shall have the right to live in a new or substantially rehabilitated unit in the new Columbia Point Development. You are receiving this Rehousing Guaranty as the head of the household. Doubled-up households each receive their own Rehousing Guaranty. This Guaranty is controlled by the agreements which follow.

1. You may transfer this Rehousing Guaranty only to either (a) another adult member of your household if they were reported on the Tenant Status Review ("TSR") as living with you in the apartment as of October 1, 1984 or (b) the person or persons who take care of your spouse and children if you are the head of your household and you should die or leave before your family is rehoused. If you do transfer this Rehousing Guaranty to one of the persons just described, you have given up your own rights to get a new or rehabilitated unit in the new Columbia Point Develoment.

2. Your family must be living at Columbia Point or be living in a temporary apartment as part of a relocation approved by either the BHA, CMJ and/or Peninsula Partners as part of the rehabilitated unit in the new Columbia Point at the time your new or substantially rehabilitated unit is ready for you to move into.

3. We agree that you will be offered a new or substantially rehabilitated unit of a size appropriate to your family needs at the time of your rehousing, as quickly as possible (consistent with the economic and racial mix goals which have been established for the project) and that you will be rehoused wherever possible in one move. Family size will be determined by the then most recent TSR. Additions to your household after October 1, 1984, will be allowed only for immediate family members or otherwise in the reasonable discretion of the BHA.

4. If you must be temporarily relocated during construction, you will be offered an appropriately sized unit, in decent, safe and sanitary condition, with functional appliances and adequate security. Any such temporary relocation will be on-site unless you choose otherwise, and will be done so as to keep to a minimum any disruption or inconvenience to you.

5. In determining the location of any temporary apartment for you and in determining the location of your permanent new unit, consideration will be given to medical, employment and other special household needs you may have.

6. You will receive at least thirty (30) days written notice of your relocation and rehousing so that you will have adequate time to prepare to move.

7. You will be provided with relocation services and benefits for both your temporary and your permanent move which will be at least equivalent to the services and benefits which are provided under the United States Government's Uniform Relocation Act or which are provided under the Massachusetts Relocation Act, whichever is greater.

8. You cannot be denied temporary or permanent housing under this Rehousing Guaranty unless you are actually evicted for cause of for non-payment of rent or you are permanently removed from your unit and your tenancy terminated by court order, in accordance with applicable law and the terms of your BHA or Section 8 temporary relocation lease.

9. Your rent, either in temporary or permanent housing provided under this Rehousing Guaranty, shall not exceed 30% of gross household income. This 30% maximum shall apply whether or not you are eligible for any public rental subsidy, and shall continue throughout your residency in the new Columbia Point Development.

10. It is anticipated that the new Columbia Point Development will be owned and managed by the private parties signing this Rehousing Guaranty and, therefore, that those private parties shall provide you all your rights and benefits under this Guarantee. The BHA already has obligations to you under its lease with you and applicable law. The BHA assumes no additional obligations by signing this Rehousing Guaranty, but for good consideration provided, gains the right to enforce this Guarantee on behalf of any or all the Tenants of Columbia Point.

11. Any disputes arising about your rights under this Rehousing Guaranty shall be resolved through the BHA Grievance Process, the Management Board of the Columbia Point Development, and/or other procedures available under applicable law.

SAMPLE

We, the BHA, CMJ, Peninsula Partners and the Columbia Point Community Task Force, Inc. have signed this Rehousing Guaranty as evidence of our agreement to rehouse you in the new Columbia Point Development as described above.

Executed this ________ day of ____________, 1985.

BOSTON HOUSING AUTHORITY

By: Doris Bunte
Its Administrator
Hereunto duly authorized

CMJ MANAGEMENT COMPANY

By: [signature]
Its President
Hereunto duly authorized

PENINSULA PARTNERS
By, CORCORAN, MULLINS, JENNISON, INC
Its Managing General Partner

By: Joseph R. Mullins
Its Executive Vice President
Hereunto duly authorized

COLUMBIA POINT COMMUNITY TASK FORCE, INC

By: Esther Santos
Its Clerk
Hereunto duly authorized

RECEIPT acknowledged by ______________________ on ______________, 1985

TRANSFER: I, ______________________, the Tenant listed above, hereby transfer and assign all of my rights and interest under this Rehousing Guaranty to ______________________, who shall hereafter be the Tenant under this Rehousing Guaranty.

Executed under seal this ____________ day of ____________, 1985